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TO ADVERTISERS

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Monday noon to ensure publication in that week's issue.

At the annual convention of the American Institute of Electrical Engineers, to be held at Great Barrington next week, a fine programme of papers is offered, and we are pleased to see that the subject of engineering education is to receive prominent attention. A discussion of this subject by our leading men of long standing in the profession can not fail to be fruitful of ideas of the greatest value to education, to students and to the Institute itself. To the Institute it deals with a subject of vital concern, for it is from our coming engineering graduates that its future membership is to be made up. It is the young men from our technical schools who will in the next generation take up and carry on the work of upbuilding electrical engineering and the electrical industry, the foundations of which have been laid so deep and broad by the splendid band of pioneers included in the membership of the Institute.

THE TELEPHONE INVASION.

Among the unparalleled electrical activities which are characteristic of this time and of this country none possesses greater interest than the progress in telephony which is being made to-day by both the Bell and Independent companies. On the farm and in the workshop, on railroad trains and on steamships, the sound of the telephone bell is to be heard. In the smallest hamlet and in the greatest city it is rapidly pushing its way into home and office, and there performing a work which would otherwise remain undone.

Marvelous as the growth has already been, we are satisfied that it has but just begun. In some small centres, to be sure, nearly all of the possible users have been reached. These are exceptional cases, and in them the movement toward greater numbers will depend on the growth of the population and general business development. In the cities and in the country at large, although telephones are being installed by the hundreds of thousands, it will still be many years before all who require telephone service will be supplied. When we consider the vast multitude who have not yet taken advantage of the great economies resulting from the telephone service, and when we consider the rapid increase of the population of the country, it is impossible to predict anything but long-continued prosperity for the telephone industry.

One of the most interesting and important of the latter-day features of telephone progress is the "Private Branch Exchange," which is a type of apparatus being installed by the thousand throughout the United States, and particularly in New York and the larger cities. It is intended for the use of subscribers who have need for more than one line to the central office, and consists of a small switchboard, varying from five to several hundred lines in capacity, and a sufficient number of lines is provided extending from it to the central office and also to the various departments of the subscriber. By its use, the busy telephone subscriber, seated at his desk, whether in office or factory, can communicate at will with his clerks, manager or workmen, as well as with the most distant points reached by the telephone systems. These small switchboards are operated by an attendant in the employ of the subscriber who receives from the central office all calls and distributes them to the proper party or intercepts them, as the case may require. Complaints have often been made, and justly so, that the telephone on the desk was often a source of annoyance to the business man, owing to the necessity of his answering the central office and holding at that time an interview which, had the call been made in person, would have been deferred until a more convenient time. It has often happened that, failing to obtain an interview in person, the knowing ones have called by telephone from a near-by office or pay station, and in that way accomplished a result which otherwise might have required hours or days of waiting. This has been regarded as a clever trick, but it must be said that the advantages are on one side only. By means of the private branch exchange, the busy man has at his command a means to protect himself against intruders by telephone which is even more effective than those which he ordinarily employs to guard the privacy of his office. Acting under instructions given from time to time, the private branch exchange attendant can intercept or divert any or all calls to any station. In cases of doubt or special urgency, the attendant can readily ascertain whether a given call would be then received or deferred. In this way an unpleasant source of annoyance has been removed and the scheming telephone intruders have been circumvented.

Valuable as the private branch exchange has proved to be in business offices and factories, its application to

hotel conditions has proved to be of equal if not greater importance. Nowadays, no architect thinks of erecting a modern hotel without first consulting the telephone engineer and laying out a system of telephone intercommunication between rooms and office and between the various working departments of the hotel. All who have used the telephone in the room of the modern hotel can not fail to note its marked superiority to the old-fashioned push-button system with its delays, mistakes and inconveniences. The saving in bell-boy service and the increased comfort to both guests and hotel officials go far to make up for the costs of the service, and when the hotel switchboard is provided with trunk-line connections to the telephone system at large the value of the hotel telephone is vastly extended and puts the traveler in immediate touch, not only with the telephone system of the city in which the hotel is located, but through the long-distance wires, with the country at large and with his own home. The better class of existing hotels is rapidly adopting the telephone in place of the push-button, and the time is not far distant when those hotels not equipped with the telephone in every room will be regarded as old-fashioned.

With this development of the private branch exchange has come a demand for a new class of office employé, the private branch exchange attendant or operator. Where these attendants are employed by especially busy concerns, their duties are solely with reference to handling the telephone calls. In cases where the number of lines is not sufficient to fully occupy the time of the attendant, it is customary to combine with the work some clerical duties. But in every case the position is one calling, not only for a knowledge of telephone operating, but for good judgment and tact. These attendants are usually young women; the work is light and agreeable and often confidential, and they are well paid as a rule.

Probably nothing would better bring out the degree to which the telephone invasion has already extended than to state that in the Cortlandt street district of New York there are employed at the subscribers' premises at private branch exchanges more than twice as many operators as are at work in the central office itself, and in the city at large that the number of private branch exchange operators is twenty-five per cent greater than the number of operators employed by the telephone company itself.

CANDLE POWER.

Is it not time that this misleading term were dropped from our practical glossary? It is an old-fashioned comparative term, and in present time, especially in arc lighting, it is useless. For example, a town contracts for street lights, and the specifications set forth so many lights of 1,200 and so many of 2,000 "candle-power." The local lighting company furnishes such lights. The municipal authorities get the idea the lights are not up to standard. How can the dispute be settled? Lately a case of this kind has occurred. The authorities wanted to learn quietly as to what they were actually getting. Opinions given from optical standpoints varied. An open test by an expert would not do. Probably the matter is still undecided.

The unit should be measurable right on the spot, as simply as checking up a bushel basket, gallon can, a yard stick or a cubic foot. If the power of the light were, as it should be, considered as a resultant of a specified current and difference of potential, with a standard length of arc and diameter of carbons, all difficulties would probably cease.

Then the disputants could take ammeter, voltmeter and calipers right to the culprit lamp and catch it in the act, without benefit of expert, jury or judge, and settle the whole matter out of court.

THE PROPER DIRECTION OF AUTOMOBILE IMPROVEMENT.

The remarks of the ELECTRICAL REVIEW on "Automobilism" in its last issue attracted the notice of our observing daily contemporary, the New York *Times*. This widely read journal, we are sure, voices a widespread sentiment when it endorses our position, as follows:

Our own criticisms upon automobile racing and racing automobiles are repeated and strengthened by the ELECTRICAL REVIEW, which, with the Staten Island accident as text, gives to both the makers and the users of automobiles some extremely sound advice—with some incidental scolding thoroughly well deserved. Recalling the quick loss of popularity that befell the bicycle as soon as it was seized upon as a machine for the establishment of racing records, and the fact that this loss not only led to the practical abandonment of one of the most beautiful and useful inventions of the last century, but inflicted vast losses upon those who had invested their capital in its manufacture. The REVIEW warns the automobile racers that their folly threatens the same results for the newer vehicle by giving the public an excuse for regarding it simply as a dangerous contrivance for sporting purposes. The existing hostility to automobiles is ascribed wholly to their misuse, and the makers, in devoting time and talents to meeting the demands for utterly useless speed, are told that they are suppressing another demand that would, if heeded, be the firm foundation for a great industry. Says the REVIEW: "The same money, the same ingenuity, and the same engineering skill displayed in constructing an electric automobile to cover a mile in forty-odd seconds would very likely have resulted in building a machine that would transport a truckload of goods at four miles an hour over cobblestone pavements in commercial competition with horses. This is the sort of thing that we want to see." So does everybody else whose wants are reasonable.

FUSE TROUBLES.

It does seem that after so many years' experience our electric railway engineers and inventors might have attained something better in this little detail of safety fuses. As they are, these devices are fairly to be considered protective of the motors and other parts of the equipment even though occasionally the "blowing" from overload causes a blaze for a time, and now and then a serious fire. But they do not protect the traveling public against nervous fright and dangerous panics. The latter become more marked on the elevated roads.

Apart from the alarm occasioned and the possibilities of fire, even if remote, the delay of traffic is almost intolerable. Let a fuse blow on a trolley car on the Brooklyn Bridge. Immediately the car is stopped and dozens behind it are stalled and often thousands of hurrying passengers impounded while the blown fuse is being replaced.

It seems a comparatively simple problem to arrange the fuse in such a manner that the arc can not possibly cause fire. Equally simple would it be to construct a fuse box in some sort of magazine form, so that but a second or two would be required to turn an exposed and easily accessible handle and bring a fresh fuse into the circuit and restore the status. It might even be considered possible to have this action of renewal automatic to some extent.

If inventors are shy of such a simple problem, surely our electric railway companies possess the necessary ingenuity among their mechanics and engineers. We would like to see them exert themselves in this direction.

The Organizers of the American Institute.

The Early Struggles of This Important Electrical Association.

By Ralph Wainwright Pope.

PERHAPS the most desirable possession of a society from an historic viewpoint is the original call for the preliminary meeting or organization, bearing upon it the signatures of men then eminent in the profession, whose influence was naturally sought for the initial movement. Two such lists may now be seen in the offices of the Institute, one made up of names of electricians, electrical engineers and officers of electrical companies located in New York city, in 1884, the other of those living at various points of the country, whose signatures could not readily be obtained by personal interview. But a small proportion of the names on these lists is identified with the Institute to-day, in fact many of them never went further than the mere signing of the call. They evidently thought it a good thing for somebody else to push along. When Dr. Nathaniel S. Keith, the first secretary, is mentioned as the founder of the Institute, few appreciate the persistent personal efforts at that time necessary to the starting of the work. He found the greatest encouragement in the attitude of the late Dr. Norvin Green, then the president of the Western Union Telegraph Company, whose signature heads the New York list, and who was subsequently elected the first president of the Institute, and was re-elected to a second term. To-day, it would naturally be thought that the chief executive of the largest electrical company in the country would have given little attention to the affairs of a society of this kind.

Dr. Green, however, was a faithful attendant at nearly all council meetings, and during that formative period he drew upon his experience to aid in every way the building up of an organization which he believed had a great future before it.

Dr. Keith was a member of the American Institute of Mining Engineers, and the constitution of that body was followed very closely in adapting it to the requirements of the comparatively new profession of electrical engineering.

At that time the title of electrician had fallen into ill repute. With the advent of electric bells, annunciators and burglar alarms, every bell-hanger and locksmith had added "electrician" to his card, sign and advertisement, and the higher practitioners sought refuge in the very limited group of electrical engineers.

Those who are familiar with the history of electrical engineering believe that the late Moses G. Farmer was the American pioneer in the profession. His practical experience in connection with the establishment of the fire-alarm telegraph in Boston led to his carrying on experimental work, accompanied by the scientific investigation of the laws of electricity, which are strong arguments in favor of this opinion.

Professor Farmer was a charter member of the Institute, and was made an honorary member in 1890. He died in Chicago, in 1893. Among his warmest friends, and an enthusiastic admirer of his genius, was the late Franklin Leonard Pope, who succeeded Dr. Green in the presidency of the Institute in 1886. Mr. Pope also had great faith in the future of the society, and it was under his administration that the practice of monthly meetings was introduced, which have without doubt been largely instrumental in the growth of the Institute, both in membership and prestige. The influence of this work upon general electrical progress has no doubt been extremely beneficial, and it is quite possible that many members may be in a position to give positive evidence in this direction.

It was at one of these early monthly meetings that Mr. C. O. Mailloux gave a practical exposition of his well-known linguistic ability. M. Julien, the distinguished inventor of the storage battery bearing his name, was a guest at the dinner, which was followed by the presentation and discussion of Mr. T. Commerford Martin's paper on the "Electric Railway." As M. Julien spoke in French, Mr. Mailloux translated in instalments, so that not only did the audience get a good idea of the speaker's remarks, but the stenographer was enabled to prepare a suitable record for the Transactions. This practice has never since been so successfully carried out at any of the meetings.

Another of the pioneers, more especially in dynamo work, was William Hochhausen, an expert mechanician, formerly employed by the old firm of Charles T. and J. N. Chester, whose factory was on Centre street, opposite the Tombs. When the writer was employed by the Gold and Stock Telegraph Company, at 61 Broadway, about 1874, Mr. Hochhausen brought in a model machine and exhibited it to Superintendent George B. Scott. It was either a dynamo or a magneto generator; probably Mr. Hochhausen could tell all about it, but he certainly continued in this line of work, which led to the organization of the Excelsior Electric Company. A little later than this a dynamo was installed by the late J. Billings Fuller in the Western Union Building, about 1878. During this interval the operating department and offices of the Gold and Stock Telegraph Company had been removed to that location, and the current from the Fuller dynamo was used for a working circuit in the building, upon which were several tickers in actual service. The experiment was conducted under the supervision of Mr. George A. Hamilton, then electrician for the Western Union company.

The current generated by the Fuller dynamo was entirely satisfactory, much to the surprise of many who thought that nothing could equal the carbon battery. Yet the carbon battery itself was something of an innovation, as the original ticker service, established in 1868, was supplied with current from a Grove battery, which was certainly effective, but a terror to all who were obliged to care for it, as well as to those who occasionally came in contact with its fumes. The care of these batteries must have been wholesome work, however, for Michael Breslin, who was a patriarch in the service at that time, is still in the harness. Driven from the battery room by the complete triumph of the dynamo, he took refuge in the City Register's office, where he has been employed for many years.

The name of Anthony W. Dimock was more familiar on Wall street than in the electrical field. His name appeared on the original call, because of his holding the presidency of the Bankers and Merchants' Telegraph Company. This was a mere episode in his career, which was meteoric. The first peak in the curve of his life occurred about 1866, when as a

mere tyro in finance he made a lucky turn in New York Central for his employer, and was soon on the road to fortune. The writer first met him at Tarrytown, where he purchased from Mr. Maynard (inventor of the Maynard rifle) "The Castle," which he enlarged and remodeled. About this time he started the historic "Quality Hill" boom in Elizabeth, N. J., which left a financial wreck, not to be forgotten during the ordinary lifetime. He rose again, however, and eventually became the head of the leading opposition telegraph company, which went down in another crash. Mr. Dimock is an amateur telegrapher, mechanic and photographer, and has practically retired from the eye of the public. Possibly a little later he may be heard from, but the indications are that while he now prefers a quiet life, in the "street" he no doubt appreciated the answer to the conundrum propounded to his host at Tarrytown, "who was the shortest man mentioned in the Bible?" "Peter, when he said 'silver and gold have I none.'"

The name of George B. Prescott, formerly electrician of the Western Union Telegraph Company, naturally suggests the name of George B. Prescott, Jr., who was generally supposed to be a son of the former. He was not his son, but a nephew. His father was Alphonso Prescott, also a telegrapher, and at one time manager of the Pittsfield, Mass., office. George B. Prescott was formerly manager of the Springfield office. During my term of service at the New Haven office, under Sidney B. Fairchild, Mr. Prescott was sent there to install the first Hicks repeater. Expeditions of this kind probably formed stepping-stones to his later position as electrician of the Western Union Telegraph Company. Eventually he was elected vice-president of the American Speaking Telephone Company, a subcompany formed under Western Union auspices, for the exploiting of the telephonic inventions of Edison, Gray and others in opposition to the National Bell Telephone Company. It was first supposed that his subsequent relations with the Western Union management were not entirely harmonious. The last time I met him he had just written, and was paying at a window of the Western Union office, for a telegram to Newport. "So you have to pay for your messages now, like the rest of us," I said to him. Of course he was well able to do so, but he smiled as he replied, "Yes, but I suppose they would offer me a book of franks if I would give them the satisfaction of asking for it." Many of your readers will remember the untimely death of George B. Prescott, Jr., in 1892. He was one of the brightest young men in the business. He was not a college graduate, but was privately and thoroughly tutored by Mr. George A. Hamilton, and was identified with the commercial introduction of the storage battery in this country as electrical engineer of the first important company devoted to that work.

The name of L. G. Tillotson will for many years to come linger in the memories of those who were in the electrical business during the 80's. He established a railway and electrical supply business while the Chester Brothers were in the field. The late Miles W. Goodyear, and T Jarrard Smith, now in a similar line of business on Nassau street, were both associated with the firm known as L. G. Tillotson & Company, of which General E. S. Greeley was a partner, and continued the business for several years after Mr. Tillotson's death.

The late James Hamblet returned from the Pacific coast in the 70's, where he had been engaged as a manufacturing electrician. While litigation was at its height over the telephone patents the late Jesse H. Bunnell embarked in the manufacture of magneto telephones, which finally developed into the business existing under his name today. Jesse, as he was always called, was an army telegrapher, and served in that capacity during the Civil War with great distinction. He was a skilful operator, and endowed with no little mechanical and inventive ability. His models were artistically designed, and his telegraph sounders have always been highly appreciated by the craft.

When the Metropolitan Telephone and Telegraph Company was organized Mr. Robert Brown was appointed superintendent of construction. He had been engaged in this line of work since about 1860, when he came from England, and was first employed in the engineering department of the American Telegraph Company, under General Marshall Lefferts. He subsequently became a contractor, and finally retired from active work, with a competence, about twenty years ago. He withdrew from the ranks so effectively that the impression gained ground that he was dead. This is not the case however, for he is still in good health, and bears up well under accumulating years.

Not long after becoming secretary I was rather nonplussed by the free and easy manner in which the affairs of the treasury were conducted. It was my duty as secretary to turn over to the treasurer all funds received, which were then supposed to be deposited in the bank. Having received a complaint that a certain check had not been returned to the maker, I made an investigation and found that the receipts for about two months had been deposited, it was true, but in a table drawer instead of the bank. The next year Mr. George M. Phelps, Jr., was elected treasurer, and it is needless to add that until his death, and since the election of his successor, Mr. Hamilton, no such loose practice has prevailed. I had not even been able to ascertain where the funds were deposited or whether a balance existed, but about two years later was surprised by the receipt of a statement from the National Bank of the Republic showing a balance to the Institute's credit of $31.85, which the cashier willingly turned over to the new treasurer and the account was closed.

As is usually the case with a new association the first year's experience with the original constitution of the Institute developed many defects and it was deemed necessary that it should be amended. A special meeting was called for this purpose, December 8, 1885, in response to a general wish expressed at the May meeting of that year. Judging from the attendance of only eight members there was no intense interest displayed, but possibly the result was just as satisfactory. The chair was occupied by the late Major O. E. Michaelis, then a captain in the United States Artillery. Captain Michaelis was a member of the American Society of Civil Engineers, and the meeting profited by the attendance of Mr. John Bogart, then secretary of that society. Mr. Sidney F. Shelbourne and Mr. Joseph Wetzler took an active part in the amendment of the constitution, so that although but a small representation was present, the work was so thoroughly done that no further change was found necessary until September 27, 1892, when the present scheme for the nomination and election of officers was adopted, which resulted in the rather exciting campaign of 1893 and the election of Professor Edwin J. Houston as president.

During the first four years the office of the Institute was located wherever the secretary happened to be employed, and consequently its headquarters were at 9 Murray street during the incumbency of Dr. Keith and Mr. Martin. Then for a time the present secretary had desk room in the office of Mailloux & Rae, at 96 Liberty street, directly opposite the present offices. In May, 1886, an office was established at 5 Beekman street, and since

that date official headquarters have been continuously maintained. Several of the names I have mentioned, although appearing upon the original call for an organization meeting, were never considered as members, having afterward failed to qualify. There seems to have existed rather a hazy idea as to the objects of the Institute, and many believed the entrance fee of $5 and annual dues of $10 were altogether too high. Experience has shown that this was not the case. The sixteen printed volumes of the Transactions would not have existed, neither would it have been possible to pay office expenses and the necessary working staff with a lower schedule.

Those who have access to a set of the Transactions will find it exceedingly interesting to glance through the pages and find themselves face to face, as it were, with those who have taken part in the proceedings years ago, and have now passed away. No doubt many crude ideas will be encountered, but all have aided in bringing about the splendid development which is apparent on every hand. There seems to be no good reason why in point of membership the American Institute of Electrical Engineers should not in ten years equal, if not exceed, that of any other national engineering society.

American Institute of Electrical Engineers' Annual Convention at Great Barrington, Mass., June 18, 19, 20 and 21.

Why go to Great Barrington? That was a question put to the secretary by a prominent member of the Institute, after he had read the announcement in the electrical journals that the nineteenth annual convention was to be held in that town.

There are many members who have made it a point to attend these annual gatherings, and last summer one of them frankly announced that he was tired of going to cities, especially during expositions. Why not go to a country town, and instead of being a mere bob on the tail of a kite, let the Institute meeting be the whole thing. The suggestion was received with enthusiasm. The secretary had in his pocket a telegram from William Stanley inviting the Institute to meet at Great Barrington in 1902. He knew something of the place, as during the early part of his life it was the greatest, in fact the only town he had visited. Surely most of the electrical engineers have heard of the Berkshire Hills, and among them there is no prettier village, and none has better facilities for the holding of a convention. For that purpose, said Chairman Rice, the "Berkshire Inn" is ideal. Its music hall will seat 400 people, and its dining-room will accommodate 200, while its broad, shady piazzas offer every facility for those animated discussions which take place between the sessions. It is beautifully situated on the corner of Main street and St. James place, the latter leading to the new station on the Berkshire Division of the New York & New Haven Railroad. Ten minutes' walk up Berkshire Heights is the new "Barrington," opened last season, occupying a sightly, breezy location with a beautiful outlook down the Housatonic Valley. All the rooms in this house have been engaged, together with about seventy rooms in the "Berkshire Inn," the "Hotel Miller" and numerous private houses will be available, in fact the entire village is at the disposal of the committee if necessary to ensure the comfort of the guests.

Great Barrington of to-day is the metropolis of southern Berkshire, with electric lights, aqueduct water, postal delivery, telegraphic and telephonic communication. The New York, Albany and Springfield mails arrive at 8.35 A. M., New York morning papers at 10.10 o'clock A. M., and evening papers at 7 o'clock P. M. The running time from New York is three and one-quarter hours, from Albany one and one-half hours, from Pittsfield one hour, from Boston five hours.

The proceedings will be reported daily in the Pittsfield papers, and possibly the local Berkshire *Courier* may honor the occasion with a special convention issue.

It was in Great Barrington that the alternating-current system was experimentally developed by Mr. Stanley, and where the factory of the Stanley Instrument Company is now located.

It was expected last year that the Berkshire Electric Railway through this region would be finished before June. It is not yet complete. There are no finer drives in the country than in southern Berkshire, and bicycles and automobiles are provided for by the excellent roads.

Those members who have never visited Great Barrington will find it at its best in June, and those who are familiar with the old town should not omit revisiting it under such favorable auspices. Recent conventions of the Institute have brought together the brightest intellects in the profession, and the surroundings on this occasion will be found most favorable for renewing old acquaintances and bringing out the best thoughts of all. Upon the return trip the question may well be asked, "Why didn't we think of Great Barrington before?"

Electrical Men Enjoy Planked Shad.

Mr. Charles E. Trump, president of the Novelty Electric Company, Philadelphia, Pa., annually extends to several of his friends the compliment of a planked shad dinner. The ninth anniversary of this event was celebrated on Thursday, June 5, at Washington Park, on the Delaware River, near Philadelphia. Shad that were caught at 10.30 A. M. of that day were planked and served to the party at 1.30, and it is needless to say that under these conditions the king of fishes was at its best and proved a revelation to those members of the party who had never participated in such an event on the banks of the Delaware.

Among those present, besides the host, were Mr. George P. Steel, of Williamsport, Pa.; Mr. E. B. Baker, of New Haven, Ct.; Colonel Ezra De Forrest, Captain W. L. Candee and Mr. George T. Manson, of New York.

Hon. W. H. Thompson, the owner of Washington Park and several of the electric railways that run to it, joined the party before its adjournment and extended a welcome to his electrical friends. Mr. Thompson has just completed the most extensive roller coaster system in the United States at a cost of $60,000, and this unique entertainment, as well as many others presented at Washington Park, were zealously participated in by the entire party.

Before separation an organization was perfected of which Mr. Charles E. Trump is president, and Mr. W. L. Candee secretary, and a particularly unique celebration of the tenth anniversary in 1903 was planned.

Electric Railways in Malaga.

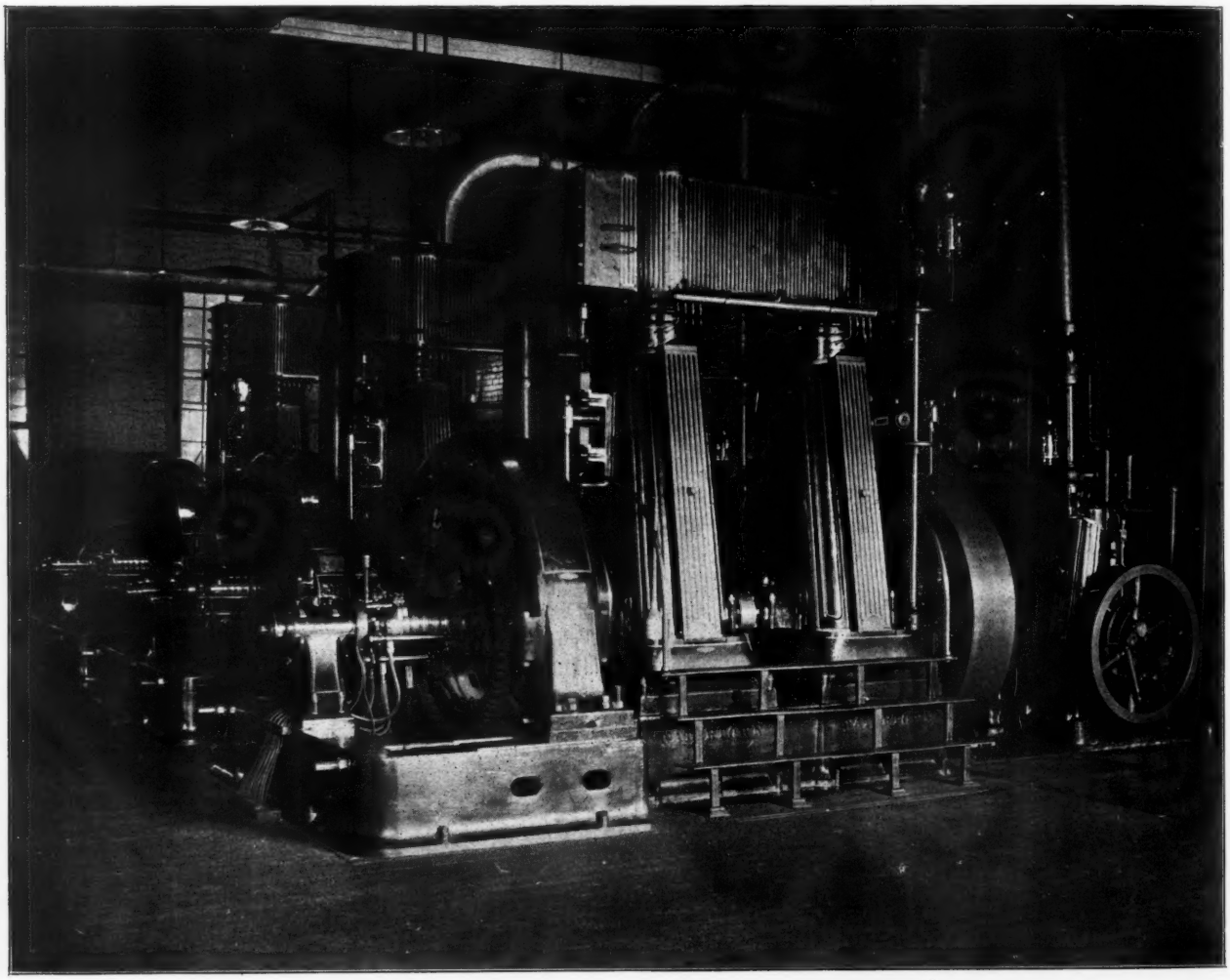
The municipal council of Malaga has finally authorized the company operating the street railway system of this city to apply electric traction to the several lines. The mileage of the company at present in operation is comparatively insignificant, consisting of only about eight miles, but concessions have been granted for various other streets, and the system is sure to expand considerably at no distant day.

The company owning the system is a joint stock society, with headquarters in Brussels, Belgium. The corporate name is "Tramways of Malaga." The directors are Messrs. Adh de la Hault, P. Hammebeath, Charles A. Lucas, Paul Mayer and Max Ryndzunsky, all of whom reside in Brussels. It is said to be the intention of the company to go to Germany for its entire electric equipment. It is possible, however, if the matter were thought to be of sufficient importance, that enterprising American agents might interfere with this plan.

An Interesting Railway Shop Power Plant.

The Power Distribution System in the Pennsylvania Railroad's Fort Wayne Shop.

THE ELECTRICAL power plant of the Fort Wayne, Ind., shops of the Pennsylvania Railroad is interesting as an example of the modern method of distribution of power from isolated stations and also as an illustration of the manner in which an old establishment yields to evolution in the gradual substitution of electric motors for driving shafting, large machines, etc., in place of long-belt transmission or scattered steam units.



THE DIRECT-COUPLED GENERATORS, PENNSYLVANIA RAILROAD, FORT WAYNE SHOPS.

The power-house of the Pennsylvania shops is situated in the midst of machine shops, forge shops, round houses and numerous other buildings that comprise the Fort Wayne shops, and is about 100 feet square and one story in height. The boiler room occupies one entire side and is about forty feet wide. An elevated track extends along the outside and coal cars are unloaded into bins beneath the tracks from which the coal is supplied directly to the boilers by hand. The boiler plant consists of two pairs of 150-horse-power return tubular boilers cross-connected so that any combination desired can be used for supplying steam for the engines in the next room. The boilers face toward the outside of the building so that the steam mains lead directly through the brick partition to the engine room. They are operated at 150 pounds pressure, using natural draft only, and besides the engines they operate steam hammers, etc., in the shops.

The engine room occupies the other part of the building and is about 60 by 100 feet. The engine equipment consists of three vertical cross-compound condensing Watertown engines of 162 nominal horse-power each at 277 revolutions and 12-inch stroke, two 25-horse-power vertical engines of the same type and one horizontal Ingersoll-Sergeant 50-horse-power engine. Each of the three 162-horse-power engines is direct-connected to a 60-cycle 100-kilowatt Westinghouse three-phase 220-volt generator, revolving armature type. Each of the two 25-horse-power engines is direct-connected to a 15-kilowatt Westinghouse 125-volt direct-current generator, running at 400 revolutions. The 50-horse-power Ingersoll-Sergeant engine is part of a two-stage air

compressor set supplying compressed air for various purposes about the shops.

Alternating current at 220 volts is distributed by the four-wire system to induction motors, constant-potential arc and incandescent lamps. The Westinghouse alternators are supplied with field-currents from the small direct-connected generators which also supply current for charging storage batteries on some of the parlor cars using this method of car lighting.

The switchboard was built by the Fort Wayne Electric Works and consists of nine panels, each panel made up of two slabs of blue Vermont marble 2 inches thick and 30 inches wide, the upper part being 62 inches high while the lower is 28 inches high and flush with the floor. The total height of the switchboard is 7½ feet and total length 22½ feet. It is supported by an angle iron frame bolted at the bottom to 6-inch channel irons resting on a brick foundation and fastened at the top by wrought-iron braces on the wall.

It is equipped to accommodate two shunt-wound, direct-connected, direct-current, 15-kilowatt, 110-volt generators used as exciters for three 100-kilowatt, three-phase, 220-volt, direct-connected, compound-wound alternators; two constant-current series arc machines, and two three-phase, 30-horse-power, 220-volt induction motors direct-connected thereto.

Beginning at the left, panels 5, 6 and 7 are similar, each a complete generator panel equipped in front with three Wood alternating-current 500-ampere ammeters, two synchronizing lamps, a triple-pole double-throw generator switch, a single-pole double-throw neutral switch, a synchronizing plug-switch, two non-arcing generator field plug-switches and a double-pole double-throw compensating switch for generator field compounding in parallel running, and in the rear with a generator field rheostat regulated by a hand-wheel in front. Two sets of bare strip copper bus-bars are mounted on the back of the first six panels, each supported from the switchboard frame by rods insulated with porcelain tubes.

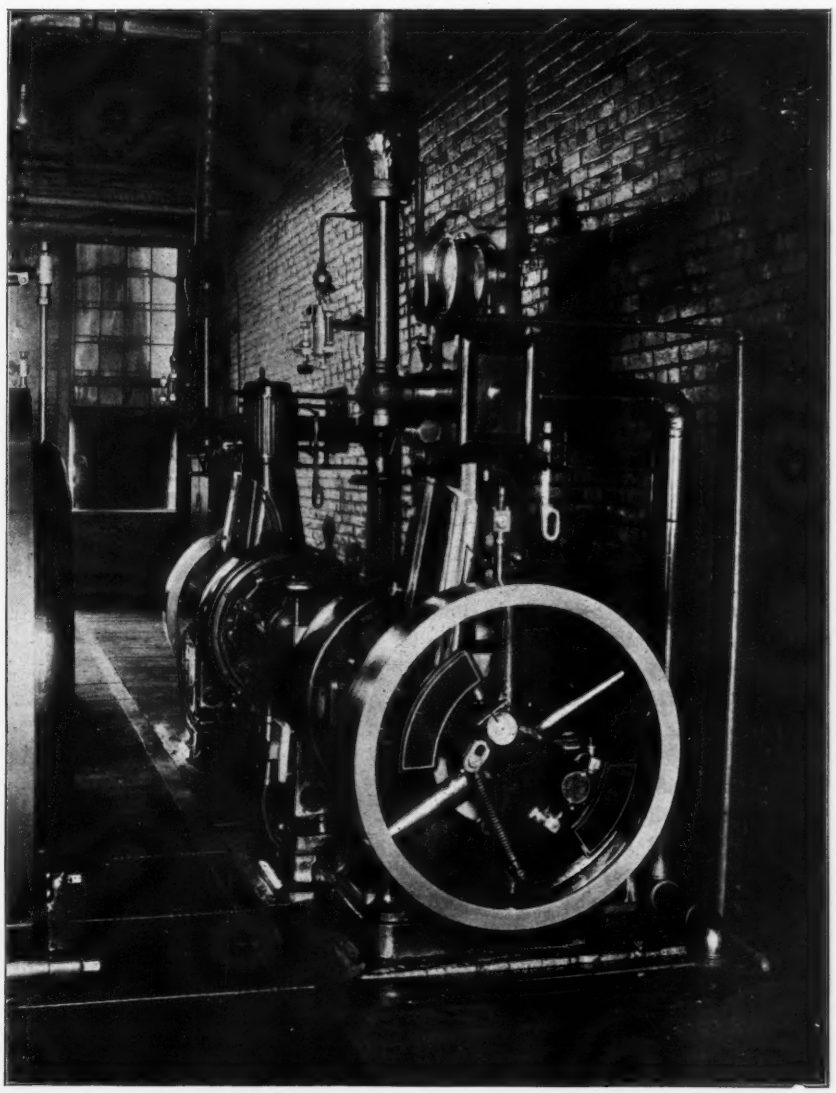
The double-throw switches permit the use of any or all alternators on either bus-bar, and field-compounding in either direction for parallel running.

Panels 2 and 3 are feeder panels for the three-phase generators. Each contains three 3-phase wattmeters and three triple-pole double-throw switches connecting feeders to either set of bus-bars. Panel 2 supplies two incandescent lighting circuits with about 1,500 sixteen-candle-power lamps and one constant-potential arc lighting circuit.

On panel 3 the upper switch is the main power-circuit switch, the middle switch supplies current to the two General Electric 30-horse-power induction motors direct-connected to the Wood series arc dynamos, and the lower switch connects with two 37.5-kilowatt, Wood type, N. D. transformers. These transformers step up from 220 volts to 2,000 volts at which current is transmitted two miles across the city to the east yards, where part is used to drive a 2,000-volt Westinghouse induction motor direct-connected to an Ingersoll-Sergeant air compressor, and the balance stepped down to 110 volts for incandescent lighting.

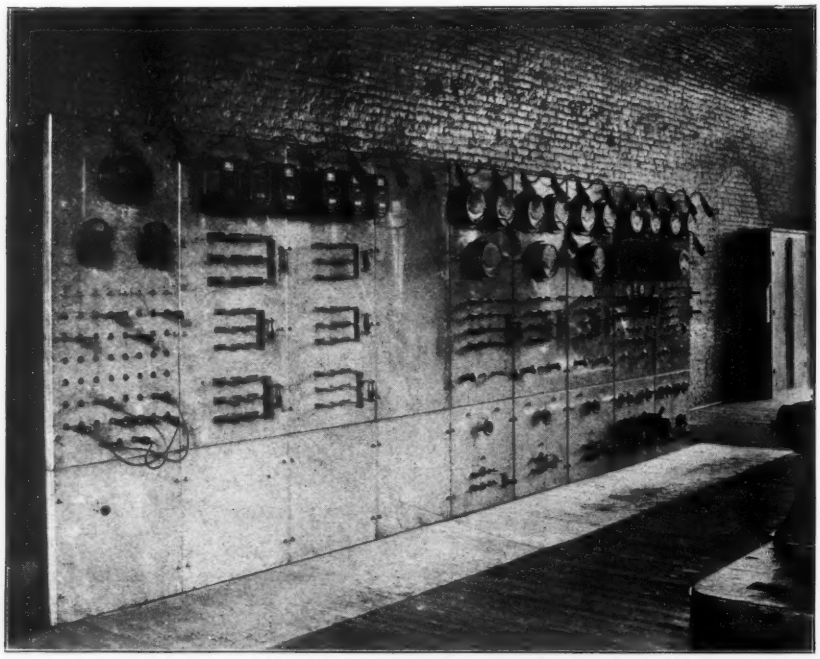
The first panel is for the No. 7 Wood constant-current series arc dynamos and contains a Whitney high-range voltmeter, two Whitney arc ammeters and sockets for four dynamos and four-line circuits. At present one hundred 2,000-candle-power arc lamps are being operated by the two arc dynamos which are shown in the illustration with this article.

Panels 8 and 9 are for the 110-volt exciter generators and circuits supplied by these machines. Panel 8 is equipped with two 400-ampere Wood direct-current ammeters indicating total exciter load and separate lamp load on exciter generators, and a swinging panel containing two Wood alternating-current voltmeters, one for alternator voltages and one for bus-bar voltages. By means of a four-pole double-throw switch voltmeter No. 1 may be connected with either set of bus-bars, and by means of a twelve-point rotary switch and a push-button ground-detector switch and lamps each circuit can be



DIRECT-COUPLED EXCITER SETS, PENNSYLVANIA RAILROAD, FORT WAYNE SHOPS.

tested for voltage and grounds; voltmeter No. 2 may be connected to a ten-point rotary switch allowing comparison of generator voltages before throwing them in parallel. The double-pole single-throw exciter switches and one double-pole double-throw generator field switch allow the use of either exciter on the alternator field bus-bars, the change being made without interruption to operation. The lower part of the panel contains the exciter field rheostats and two overload I-T-E circuit-breakers of 200-ampere capacity in the lighting circuit.



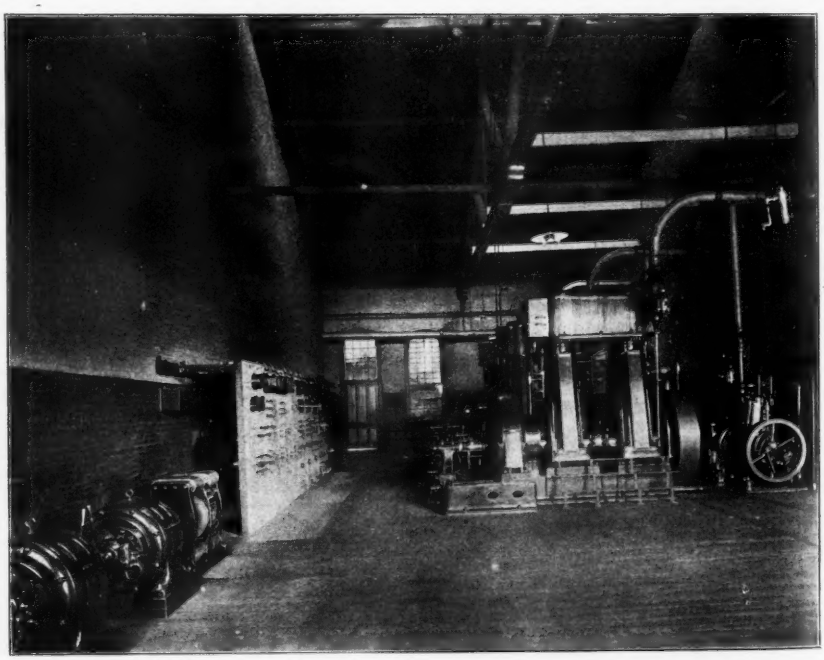
Switchboard, Power Station, Pennsylvania Railroad, Fort Wayne Shops.

Panel 9 contains the 125-volt feeders to storage batteries and constant-potential arc lamps. It is furnished with two Weston ammeters, a Weston voltmeter, two battery pilot lamps, two double-pole double-throw battery circuit switches with fuse terminals on back of board, one double-pole double-throw switch for multiple arc lighting circuit, two battery-circuit rheostats mounted on back of board with hand-wheel in front and an I-T-E underload circuit-breaker in each of the two battery circuits. On the wall back of panel 9 are four Thomson recording wattmeters for the various circuits on the panel.

All leads from the generator are carried in a tunnel to a generator fuse panel on the wall back of the switchboard, from there to the bus-bar and then to the circuit fuse panel and out through the tower to the distribution lines.

The motors supplied by these generators are all 60-cycle Westinghouse three-phase induction motors and are distributed as follows:

In the main machine shop two 30-horse-power motors drive two sections of line shafting, one carrying planers and shapers, the other carrying large boring mills, both motors operating at about 80 per cent full load continuously. In one end, belted direct to a 60-inch planer, is a 10-horse-power motor, while a new 100-inch Niles car-wheel press near-by is operated by a direct-connected 10-horse-power induction motor. Here is an illustration of the different stages of application of electric power. First, a long line of shafting divided and driven by belted motors, side by side; next, a motor belted direct to a large planer, and finally direct-connection of a motor to an air compressor.



General View of Power Station, Pennsylvania Railroad, Fort Wayne Shops.

In the boiler shop a 10-horse-power induction motor is belted to a line of shafting, while the forge shop has a 30-horse-power motor similarly installed. In the flue shop is a 40-horse-power motor belted to shafting, and a 20-horse-power and a 30-horse-power direct belted to large Sturtevant blower fans for the forges in the forge shop.

The car machine shop shaft is driven by a belted 40-horse-power motor, while the machine shop tool-room lathes are driven by a 5-horse-power motor belted to shafting.

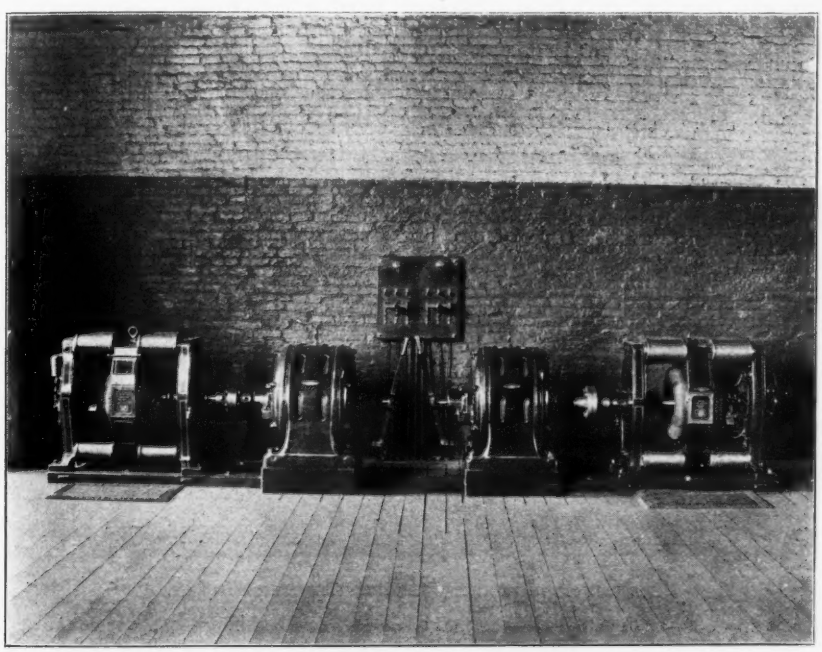
The car lighting department is experimenting with several systems of electric lighting of vestibuled trains. Among them are sixteen dining cars equipped with the Consolidated Axle Device Company's system, one equipment of the Bliss system, one with the Gould system and one direct-connected engine-generator set installed in a baggage car. The storage batteries used in these systems are charged at various stopping places, some in Fort Wayne, where connection is made with the car at the station switch yard, but most of the charging is done at either end of the division, in Pittsburg or Chicago.

Negotiations are in progress for the ex-

tension of the present machine shop and the removal of the round house to the east yards. The new machine shop will be equipped with two 60-ton traveling electric cranes, and the turn-table at the round house will be direct-driven by an electric motor and other uses for electric motors are contemplated.

This additional demand for power will be supplied by the installations of two new 200-kilowatt direct-connected generators in the power-house and additional boiler capacity in the boiler room.

The Fort Wayne shops of the Pennsylvania lines maintain the entire Pittsburg, Fort Wayne & Chicago division.



DIRECT-COUPLED EXCITER SETS FOR ARC LIGHTING, PENNSYLVANIA RAILROAD, FORT WAYNE SHOPS.

This work is one of Fort Wayne's largest industries and has about 2,000 employés on its payroll.

Aluminum.

The production of aluminum in the United States during 1901 amounted to 7,150,000 pounds. The price of aluminum per pound remained practically stationary throughout the year, although the demand for the metal increased. The total imports of all forms of aluminum in 1901 amounted to $909,748, as compared with $15,444 in 1900.

Quartz crystal can not be used like glass on account of the high temperature required to melt it. Lenses are made from it by grinding, and in recent years fine silica fibres for physical apparatus have been drawn out while the material was softened by the oxyhydrogen flame.

The Fayet-Chamonix Electric Railway.

A new Alpine electric railway, embodying a number of features of great interest, is thus described in *Engineering:*

The gauge of this railway is 3 feet 3⅜ inches, and the length 11.8 miles; it runs from Le Fayet-St. Gervais to Chamonix, following the course of the Arve, a torrential river which joins the Rhône at Geneva.

The Paris, Lyons & Mediterranean Railway Company had extended its system in this region some time ago by laying down a normal gauge line from its station at Cluses to Le Fayet. The company's intention had first been to carry the line as far as Chamonix, but seeing the difficulties which would have to be overcome in the construction of a normal gauge line in such a mountainous district, it applied for and secured the necessary power for laying down a narrow-gauge railway, and also for using the rack system of hauling the trains over the heavy gradients should this be found necessary. It further decided to have recourse to electric traction and to utilize the large water power available in the district for generating the current. In the final design of the line it was found that the rack system could be dispensed with, and the gradients are worked by adhesion.

The railway starts from Le Fayet station, at a height of 1,902 feet, and runs up to Chamonix, 3,402 feet above sea level. The sharpest curves are 490 feet in radius, and of the two steepest gradients one is 9 in 100 over 1.35 miles, and the other is 8 in 100 over 0.85 mile. The other gradients do not exceed 2 in 100. The line crosses the Bonnant torrent and the Arve at several places, where seven bridges had to be built. Five of these have steel flooring and range in span from 85 feet to 151 feet; the two others are masonry bridges, one of which has a central arch 82 feet in span by 164 feet in height, with seven side arches 49 feet in span. It runs also through three small tunnels, 83, 138 and 90 yards in length, respectively.

There are four intermediate stations: Chedde, a small village in the St. Gervais Valley and at the foot of the Aiguilles de Warens, near one of the electric generating stations; Servoz, on the banks of the Dioza stream and in close proximity to the Dioza gorge; Les Houches, at one end of the Chamonix Valley, and Les Bossons, at the foot of the well-known glacier of the same name.

A third rail is laid over the whole length of the track for current distribution. At the gradients a central rail is fixed between the track rails, on which a special shoe brake acts for limiting the running-down speed to 6.25 miles an hour. All the rails are of the same section, weighing 69 pounds per yard. The track rails are in 39-foot lengths, held on 15 sleepers with the interposition of sole-plates and ordinary wood screws; they are joined together by angle fish-plates. The brake rail is exactly in the centre of the track; angle fish-plates are also used for joining the lengths together, but in the case of this rail the fish-plates are chamfered at the top to allow the action of the brake clutches. The top of the central rail is 2.3 inches above the track level. The contact rail rests on creosoted wood blocks placed between every alternate sleeper. The contact rail fish-plates are of the ordinary flat section. The electric bonds are of the usual plastic type. The contact rail has been done away with over a distance of 16 feet at those parts where the line runs over level crossings and in the vicinity of the covered platforms, turn-tables and switches, and the two ends are connected together by copper wire cables; these are placed in a wood conduit. The contact rail itself is also protected at several places with a wood covering.

On the steel bridges the track rails are held on oak longitudinal sleepers, and the third rail is insulated on oak blocks. In order to prevent all sliding action of the track down the gradients, a layer of concrete has been placed every 320 feet, in

which old rails have been embedded; these act as abutments for the sleepers. The station platforms are 18½ inches above the track to facilitate the stepping in and out of carriages; this is contrary to the French ordinary practice, and is due to the presence of the third rail at the stations, although abundant precautions have been taken otherwise to prevent all chances of accident.

The generating stations are two in number—one at signal-post 5, near Servoz, and the other near Chavants, at signal-post 8. Their power has been based upon the assumption that after the starting of a first train on the line, a second one would be despatched 15 minutes later, a third after an interval of 30 minutes, a fourth 15 minutes later, and so on. Both the generating stations are driven by a derivation of the Arve. In that at Servoz the ground floor contains the admission pipes to the turbines, the first floor forming the engine room. The railway company utilizes as a head of water the first 140 feet of the fall, which the Société des Forces Motrices de l'Arve has regulated for its Chedde works. The water first flows into a settling chamber, 754 feet in length, built underground and lateral with the river edge, and in which the speed of the water is reduced to 18.5 inches per second; this allows the settling down of the sand and mud, which are discharged to the river again through a separate conduit. The water then passes a sluice gate and penetrates an underground masonry gallery, 1,640 feet in length, the output of which is 424 cubic feet at a speed of 7 feet 10 inches per second; it then reaches an intermediate water chamber, from which start both the supply pipe to the turbines and a discharge pipe for delivering the water direct into the canal of the Société des Forces Motrices. From the supply pipe the water runs into an underground pressure room, from which extends the pipes leading to the turbines and a conduit for the removal of sediment. The pipes are four in number, each supplying a 325-horse-power central-discharge turbine, revolving on a horizontal shaft; the pipes are 37.4 inches in diameter and rest on expansion slide supports. They supply also a receiver for working smaller turbines of 60 horse-power.

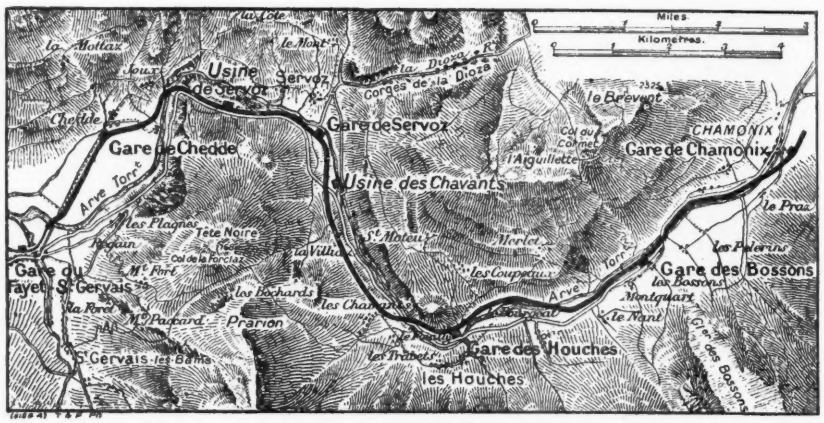
The engine room contains four 200-kilowatt 6-pole continuous-current dynamos, joined to the turbines by an elastic insulated coupling; three suffice for working the line, the fourth being held in reserve. The turbines are placed above the tail-race and are provided with suction pipes; they work under a head of 124 feet gross, and develop 325 horse-power at 470 revolutions. Two 40-kilowatt 4-pole continuous-current dynamos act as exciters, and also supply the necessary current for lighting the generating station. These are driven by an outflow turbine, with partial admission through two orifices opposite each other, the opening of which can be regulated by a circular-balanced valve worked by hand, or by an automatic speed regulator. This turbine is of 60 horse-power at 520 revolutions.

The negative pole of the generating dynamos is connected to the track rails at a point exactly opposite the generating station, and the positive pole is connected at the same point to the contact rail.

The second generating station is that of Chavants; it is contained in a similar building. The motive power is supplied by a head of water of 308 feet. The maximum power is 10,810 horse-power, and the minimum 5,640. The water supply is taken through an orifice which lies more than 6 feet above the bed of the river and but little sand is carried into the pipes. The water flows into a chamber provided with a regulating sluice; thence into an intermediate one, in which the rate is reduced to 22.8 inches per second, and in a pressure room, from which pass two pipes, each supplying a 325-horse-power turbine, and a collector for the 60-horse-power turbines. The general arrangements are similar to those at Servoz. The 200-kilowatt generating dynamos are connected to the contact rail and to the track by 4 positive and 4 negative cables. A feeder, carried on posts and joined at both ends to the contact rail, is laid between the point at which the positive cables are connected to the latter and the Chamonix railway station. The maximum pressure at the dynamo terminals varies automatically, according to the output; the pressure at the connection of the positive aerial cable with the third rail is practically constant and equals 550 volts.

All the cars are motor cars. There are four or five to a train, with a luggage van, the front part of which is provided with the driver's stand and the steering mechanism. The cars carry each 32 to 36 passengers; they have central corridors, with a platform at both ends, and are for two classes. The train represents a dead load of 120 tons, for about 170 passengers. Under these conditions, and given the heavy gradients, it was necessary that all the cars should be provided with motors, and that they should be steered by one driver only, from the head of the train. This is done by means of a steering gear designed by M. Auvert, chief engineer of the Paris, Lyons & Mediterranean Railway Company, and who had charge of the construction of the line.

This steering gear is worked by means of compressed air; the main part is placed in the driver's stand, while a secondary device of the same type is fitted up in each of the cars, and in the driver's platform also. The main steering mechanism operates all the others, and through them the electric controllers of the whole train; the gear is connected throughout by two sets of piping—one for forward and one for backward motion. The main and secondary steering devices communicate also with the air receiver on each car, from which all the brakes are worked. The air pressure is given by a compressor carried in the van and driven by an electric motor of 8 to 10 horse-power; the pressure in the receivers is maintained constant. Should a pipe burst when a train is on the line, the pistons of the steering mechanism would take up a middle position and place the electric controllers on the stop notch. Each car is, of course, complete in itself, and can run separately for service on the line; as a rule, however, the traffic is dealt with by trains worked from the main steering gear. The cars are provided with two motors, which drive the axles through conical gearing. A train of five cars, running at a speed of 7.45 miles an hour, absorbs on the up gradient of 9 in 100 800 amperes at 550 volts; the starting on this same gradient takes about 1,100 amperes. The journey lasts about one hour, counting the stoppages. As above mentioned, the speed is limited to 6.25 miles when running down the heavy gradients of 8 and 9 in 100.



PLAN OF THE FAYET-CHAMONIX ELECTRIC RAILWAY.

Electricity in the Army and Navy—II.

A Symposium before the American Institute of Electrical Engineers.

THE MILITARY CABLE SYSTEM OF THE PHILIPPINES.

BY CAPTAIN EDGAR RUSSEL, SIGNAL CORPS, UNITED STATES ARMY.

(Continued from page 762.)

In double-current working a separate switch is needed in connection with the open-circuit key to cut out the "back contact" battery when through working. This gives trouble to the operator accustomed to the ordinary switch lever, and the key illustrated was devised to overcome this difficulty. As will be seen, by altering the connections of the legs, the key may be used for either ordinary closed circuit, single or double-current open circuit. (Fig. 4.) The ordinary sal ammoniac batteries were used. It was found that very satisfactory service with the Stroh or Western Union form of polarized relay adopted could be obtained with fifteen milliamperes, and the amount of battery was adapted to that strength of current. It was soon found in the Philippines that in no telegraph office could the ordinary office wire be depended upon. Consequently nothing but rubber-covered wire was permitted to be used in the cable offices, even on the local circuits.

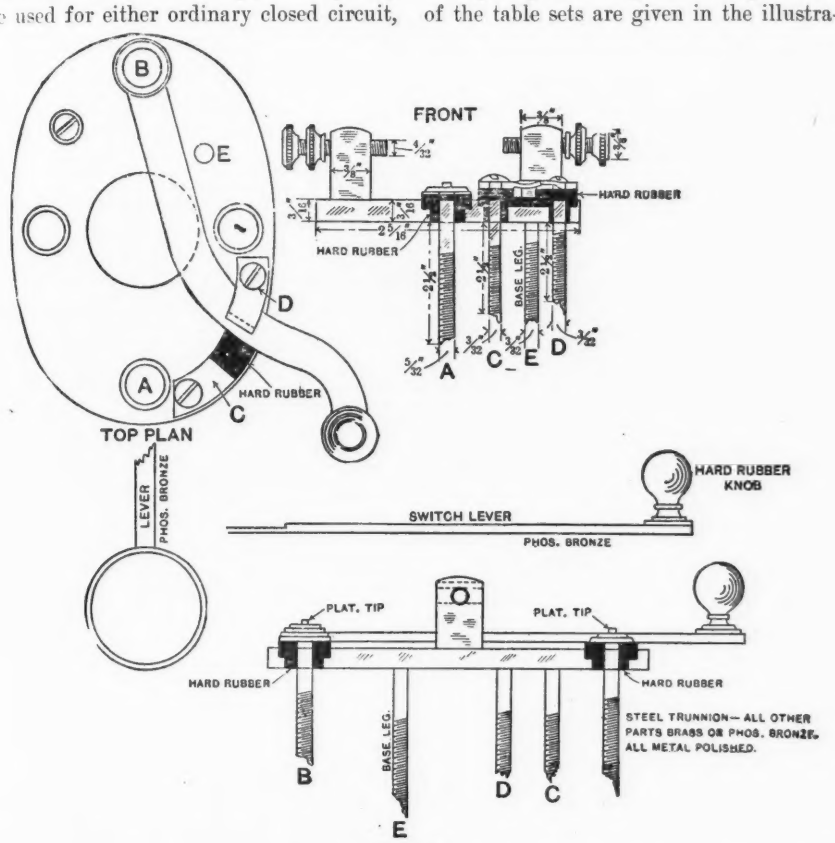


FIG 4.

Combination key for open or closed circuit (single or double current) With relay connected to E, one pole of main battery to A, earth to C, and one pole of back contact battery to D, the key is suited for open circuit working either single or double current. (Single current with switch closed to the left. By opening switch to right the back contact battery is put into circuit for double-current sending.) By connecting A and C together, and E and B together, it may be used as an ordinary closed circuit key, A and B being the points connected with line and relay respectively.

These apparently little matters made much trouble until they were remedied. The great humidity and continuous high temperature produce remarkably rapid deterioration of all office material, and, it may be added, of the operators and officers as well. As it was desired in some instances to link a number of the local cables for through working, the open-circuit repeater sets were devised. The wiring diagram and general design of one of the table sets are given in the illustrations. The complete instruments are mounted securely on telegraph tables, and the binding-posts for attachment to the batteries and lines are plainly marked. The double switch in the centre of the table provides changes of connections for independent working of the lines, or for repeating. In Figs. 5 and 6 are shown the wiring diagram and table top, respectively.

Duplex sets have been procured and sent to the Philippines (for use over the cables and land lines) in charge of a number of Signal Corps men, trained especially in working and installing them. The sections over which they are to work are as follows:

Manila-Guinayangan, 140 miles land line, polar duplex.

Guinayangan-Legaspi, 60 miles cable, 70 miles land line, differential duplex.

Legaspi-Calbayog, 157 miles cable, 10 miles land line, differential duplex.

Calbayog-Cebu, 140 miles cable, 35 miles land line, differential duplex.

These sections form an important line connecting headquarters, Department of the Southern Philippines at Cebu with headquarters, division of the Philippines at Manila. In the connecting lines there are 255 miles of land line and 357 miles of cable. The differential duplex was adopted where a cable formed part of the line in order to conform to open-circuit conditions. The instruments are readily mounted on two light telegraph tables, one for the sender and one for the receiver.

At the same time that the men were being trained in duplex working, they were being instructed in the use of cable recorders and automatic transmitters. Sets of these instruments were procured from one of the best makers, and the men were constantly drilled in sending on the double key, in perforating tape for the automatic transmitter, and in reading the recorder tape. They had obtained a fair degree of proficiency in their eight weeks' practice when they left for the Philippines. It is proposed to use these instruments over the new cable line between Batangas and Cebu direct. The sections between Marinduque, Romblon and Masbate islands are about to be laid. During most of the day it is proposed to work the line in sections by the ordinary open-circuit Morse, and at certain hours the local offices will be cut out, the lines will be linked together, and the routine reports personal and press messages and other through business between Manila and Cebu rapidly exchanged by means of the automatic transmitters, the tape having been prepared for this as messages are filed for transmission at Cebu or Manila.

If it be asked why this method of working is proposed, it may be said that the military land lines and cables, to a large extent, take the place of the letter mail in official and in much personal business.

The average message is about thirty words in length, and for many months 10,000 messages per day have been transmitted over the Signal Corps line. It was ascertained by the chief signal officer in the summer of 1901 that the average time required for sending letters from Manila to all telegraph offices on the island of Luzon alone and getting replies was about one month. It is proposed to try rapid telegraphy between Manila and Cebu to furnish some substitute for the slow mail communication. The local offices retain Morse working because it would not pay to put expensive and delicate instruments in each and train men to be experts to supply them.

Neither land lines nor cables were open, until quite recently, for commercial business and no statistics are at hand regarding a period of sufficient length to admit of estimates. The rates as first established are as follows:

First—Messages transmitted between points on the same island, two cents per word.

Second—Messages between points on different islands, four cents per word.

Third—Press specials, half rates.

Address and signature counted; the minimum charge is for ten words.

All of the cable laid in the Philippines by the Signal Corps has rubber insulation. For the trying conditions under which much of it had to be transported, stored and laid, there is no question that the choice of rubber over gutta-percha was a wise one. For example, much of the cable brought over on the Hooker was necessarily exposed to the weather for months before it could be laid. In that tropical climate gutta-percha cables would have been reduced to worthless junk, but the rubber cables had in many instances several hundred megohms dielectric resistance per knot out of the original 1,000. The rubber insulation when immersed to depths of over 900 fathoms showed steady improvement as it went down. Two kinds of deep-sea cables are in the system, the data concerning these being briefly as follows:

Conductor.	A. Seven No. 24 Copper.	B Seven No. 21 Copper.
Dia. of insulation..	8/32"	9/32"
Cop.resis.per knot	21.6 at 75° F.	9.7 at 60° F.
Die. " "	1,400 Meg. at 60° F.	750 Meg. at 75° F.
Capacity "	.38 m. f.	.38 m. f.
Armor	16 No. 12 stl. wrs.	16 No. 10 stl. wrs.
Ap.wei'ht per knot	1.3 tons.	1.75 tons.

The core in each was taped, served with a double layer of jute, armored, then served with a double layer of jute and finished with a covering of compound and soapstone. The shore end cable was similarly made but received an additional armor of eighteen No. 6 steel wires and another double layer of jute and compound. This shore end weighed about six and one-half tons per knot.

The Stations and Distances—In the cable system of the Philippines up to the present time are given below:

		Miles.
Laguna de Bay (Luzon)	Calamba-Los Banos	4
	Calamba-Santa Cruz	18
	Santa Cruz-Siniloan	9
Manila-Cavite (Luzon)		8
Naic-Corregidor Island (Luzon)		12
Guinayangan-Pasacao (Luzon)		51
Legaspi-Bacon (Luzon)		29
Sorsogon-Palanog (Masbate)		62
Batangas-Calapan (Mindoro)		30
Calapan-Boac (Marinduque)		45
Palanog-Calbayog (Samar)		75
Calbayog-Catbalogan (Samar)		37
Catbalogan-Carigara (Leyte)		45

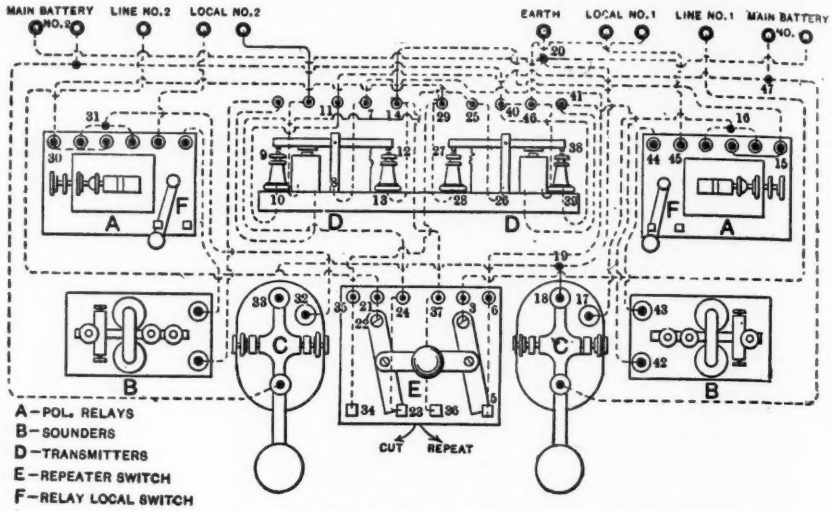


FIG. 5.—SIGNAL CORPS REPEATER SET, SINGLE CURRENT, OPEN CIRCUIT.

In all there are forty-one cable stations, with 1,297 miles of cable connecting them.

There was plenty of theoretical knowledge as to cables and cable methods among the officers of the Signal Corps when the development of this system was inaugurated. It is needless to say to the members of this Institute that theory and practice are two different things. Thanks to the resourcefulness of the American soldiers and the American officers, supplemented by most valuable advice from

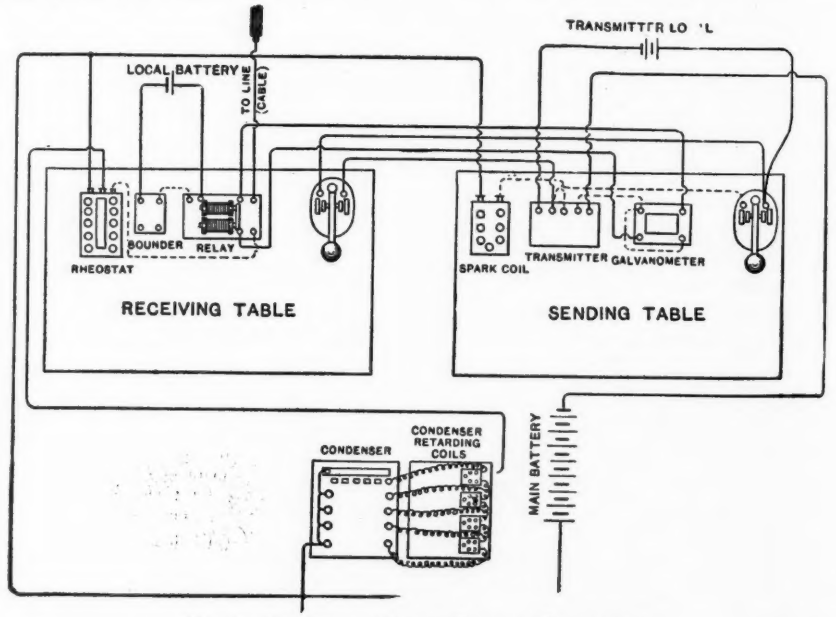


FIG. 6.—DIAGRAM OF TABLE TOP AND CONNECTIONS.

Ormoc (Leyte)-Liloan (Cebu)	72
Liloan (Cebu)	13
Milagros (Masbate)-Capiz (Panay)	74
Argao (Cebu)-Loön (Bohol)	14
Maasin (Leyte)-Surigao (Mindanao)	56
Oslob (Cebu)-Dumaguete (Negros)	17
Dumaguete-Misamis (Mindanao)	115
Misamis-Lintogup, Mindanao (no station)	23
Misamis-Iligan (Mindanao)	32
Iligan-Cagayan (Mindanao)	60
Tucuran (Mindanao)-Malabang (Mindanao)	48
Malabang-Parang Parang	24
Tucuran-Zamboanga (Mindanao)	158
Zamboango-Jolo (Jolo)	100
Zamboango-Isabela (Basilan)	18
Jolo-Siassi (Siassi)	50

the civilian cable engineers, Hamilton and Winter, the officers and men of the Signal Corps speedily developed into a most efficient cable force. Whether it was a question of laying, recovering, splicing, repairing or installing, the time soon came when work of this character was done with clockwork regularity and with

the greatest economy of time and effort. It may be of interest to state that prophecies were not lacking that American made cable would not suit the physical conditions of the Philippine archipelago. As an answer it may be said that of the twenty-nine separate submarine cables installed, not one has failed through defects of manufacture or installation. The only interruptions have been due to mechanical injuries arising almost entirely from ships' anchors and similar accidents. Perhaps there may be considered one exception, where a small stretch of cable developed some weakness in insulation during the installation, which, being removed, the cable has worked uninterruptedly for the past eighteen months. It may be added that large quantities of this cable, owing to scarcity of funds, was made under Signal Corps specifications of the cheapest possible type consistent with the work expected of it, scarcely exceeding one ton per statute mile.

It is not the purpose of this paper to speculate upon the future telegraphic conditions in the Philippines, but to attempt to show under what novel and difficult conditions the pioneer work in this field has been accomplished by the Signal Corps. The use of the best or most approved telegraphic methods, common in this or other countries, has not always been considered advisable, for the men are in most cases so much needed to fill the vacancies due to breakdowns in health, on account of the trying tropical climate, that little opportunity for preliminary training has been afforded. Furthermore, the great distance from the base of supplies makes it necessary to be very conservative in adopting appliances not proved efficient by long tests under similar conditions. The value of the telegraphic and cable work of the Signal Corps has been referred to in almost every report from district, department and division commanders, so it is pleasant to feel that success has crowned the work of the corps, and a good foundation has been laid for those who come after.

This résumé of the past would not be complete without a brief allusion to the cable situation in the Orient. It is a matter of record that France, Germany, Great Britain, Holland and Russia have greatly extended their cable facilities along the Asiatic coast. All island colonies have been or are now in the process of connection by cables with the principal colonial stations of each nation of the Asiatic mainland. Alone of all countries the United States, which has constructed in an unparalleled short time a magnificent system of nearly 8,000 miles of telegraph lines and cables in the Philippine archipelago, refrains from taking steps to connect this archipelago either with Japan to the north, Australia to the south, or, most important, with China to the west. It is believed that the engineering interests of the United States, which have forged to the front in Europe and Africa, will at an early date insist on additions which will foster the growth of American industry and commerce in the Far East.

ELECTRICITY IN THE SIGNAL CORPS.

BY LIEUT.-COL. SAMUEL REBER.

The application of electricity to the art of war has kept abreast with its development in the commercial world. The engineering conditions under which it is applied are practically the same as in ordinary life, but are prosecuted under conditions which, of necessity, must be more exacting and difficult. Efficiency and certainty of operation outweigh in the problem of design the cost of installation and economy of operation. Many ingenious means and methods of the application of electricity to the military service have been devised from time to time, but a large number proved of little value, as they have been either too complicated or too delicate. No device or apparatus which can not survive lack of attention and skilled supervision, exposure to weather, rough handling in transportation, or the effect of the blast of heavy guns, will prove of value at the critical moment of its use at the time of actual battle.

Unfortunately for efficiency, the technical corps of an army is a very small proportion of its total strength, and the pay of enlisted men is not sufficient to prove an inducement to men skilled in the use of electricity, who are much better paid for the same work in civil life, to enlist in our service. One of the greatest limitations of its development in the service has been lack of appreciation by Congress of its importance, and the consequent lack of necessary appropriations.

The Signal Corps of the army is charged with the construction, repair and operation of military telegraph lines, and the duty of collecting and transmitting information for the army, by telegraph or otherwise.

While the importance and value of rapid means of communication in the commercial world have been demonstrated by the experience of over one-half a century, and the enormous amounts of capital invested in the telegraph, telephone, and cable, such means of communication are absolutely essential to success in modern war, where time is one of the most important of controlling factors. Electricity is the most potent agent in our control to effect such a saving of time.

The service of communication in the Signal Corps is divided into field and fortress work. For field work the telegraph, telephone and cable are now employed, and possibly in the future wireless telegraphy will be, when more positive results are obtained in working overland.

In the American armies, both of the North and the South, in the war of 1861 to 1865, was the first application of the telegraph under war conditions. The advantages and results proved so satisfactory, that nearly all of the foreign powers have followed our methods, and the present modern system of field communication is but an amplification of the results obtained in that war, taking advantage of the engineering progress and the recent developments in the arts of telegraphy, telephony and cable working.

A complete chain of communication must extend in an unbroken line from the extreme outposts in contact with the enemy, back to the capital at Washington. This chain of communication is divided into three parts: permanent, semi-permanent, and temporary, or flying lines. The permanent lines are usually those of the existing commercial telegraph and cable companies, and are, ordinarily, outside of the active zone of operations, and if taken possession of by the military forces are operated under the methods of commercial practice. Semi-permanent lines are used to connect the principal base or depot of supplies on the edge of the zone of operations to the field base within it, and in this service the lines are constructed by using iron telegraph poles with cross-arms. Field or flying telegraph lines are used in the zone of active operations, and connect the field base with general headquarters and the general headquarters with all the principal subdivisions of the army; even to the extreme outposts. A detailed description of the manner of erecting these lines will be given a little later.

For working the permanent and semi-permanent lines the ordinary closed circuit system of Morse, with the usual instruments, is employed. The invention of the telephone added a valuable adjunct, and especially so for flying lines, whose construction is at times most hasty, and whose insulation is so low that ordinary Morse working is often impossible. As troops advance it is frequently necessary to lay bare wire on the ground, hang

it on trees, or even leave it in marshy ground, so that the circuit will be absolutely grounded for ordinary telegraph working. Under such conditions the buzzer has proved most successful, the delicacy of the telephone receiver making its use practicable. The buzzer is simply a coil of low resistance and high self-induction in series with a circuit-breaker, a telegraph key and battery. On opening the circuit the discharge of the coil goes to line and, owing to the high self-induction and consequent comparatively high electro-motive force, enough current reaches the telephone receiver at the other end of the line to give audible signals.

The telephones used in fortress service are modifications in design alone of the standard commercial types. Portability, simplicity and mechanical strength are the essential features covering the design of all field telegraph and telephone apparatus, and will be illustrated in the description of the following special apparatus that has been designed by various officers of the Signal Corps to cover field conditions.

While great progress has recently been made in the application of wireless telegraphy for the exchange of messages over water, its value for land communication, except in very exceptional cases, is quite problematical. The distances which as yet have been covered in land working, are of comparatively short length, and its certainty of operation without interference is as yet unproved. The existing methods of communication have proved sufficient, especially as a field line, under ordinary circumstances, can be erected at the rate of from one to three miles an hour, depending upon the character of the ground. Whenever absolutely syntonic working is achieved and interference by the enemy can be prevented, wireless telegraphy may have a valuable field on land in the future, but at the present outlook, it is much more suited to the operations afloat than ashore.

Before the outbreak of the war with Spain the cable operations of the Signal Corps were confined to maintaining the limited systems of cable communication between the various forts in the harbors of this country. When the expedition arrived off the coast of Cuba, near Santiago, the French cable leading to that point was cut, and to avoid delicate questions of neutrality the first war cable ever laid by our government was run from Guantanamo to Siboney by the

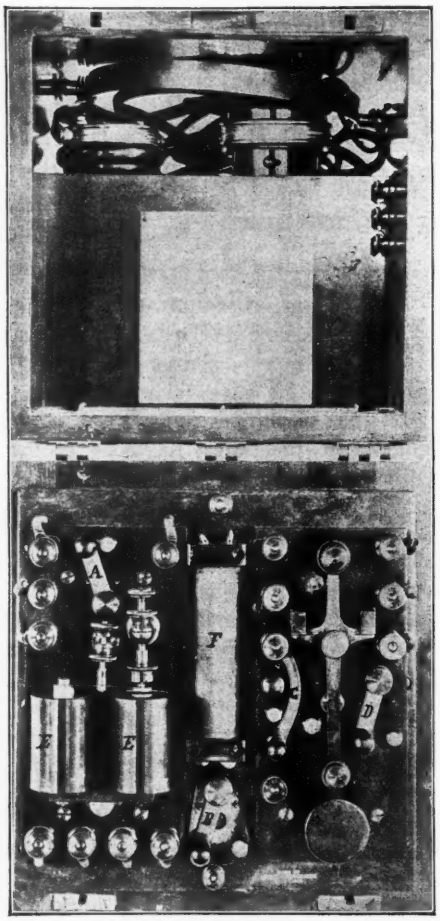


FIG. 7.—SIGNAL CORPS APPARATUS.

Signal Corps, and connected with the military line to Shafter's headquarters, so that the White House was only twenty minutes in time away from the firing line in an enemy's country.

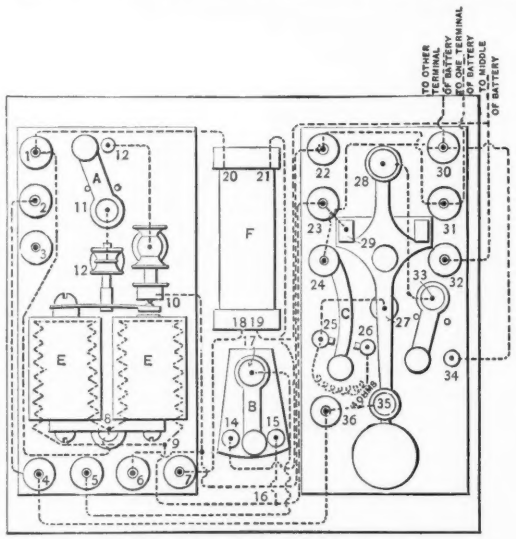


FIG. 8.—DIAGRAM OF CIRCUITS.

As soon as the Philippine Islands were occupied, interisland communication became so essential that the Signal Corps was called upon to take up the question of deep-sea cable engineering. Apart from its value as a means of communication, the establishment of the Philippine cable system gave the American manufacturers an opportunity to engage in the production of deep-sea cable, and has resulted in the establishment of such plants as will in future enable us to obtain at home this most important war material, and not place the government at the mercy of foreign producers, whose friendly interest can not always be counted upon. It is interesting to note in this connection that the American manufacturers say they are prepared to make and lay the proposed American-Pacific cable, the project for whose construction is at present pending in Congress. The importance of the early consummation of this project, both for strategic and commercial reasons, gives rise to the hope that it will be settled at this session, whether under government supervision or as a private enterprise.

The type C apparatus, Figs. 7 and 8, is designed to use the buzzer principle, and is contained in a hardwood box of cubical form, eight and one-half inches on the edge, and weighs about eight pounds. The working parts are fastened to the front, which is hinged, and when in use lowered on a table. The back is also hinged to give access to the cells of dry battery that are contained in the body of the box. The transmitter and receiver fit in the space above the battery. A condenser of one-third microfarad capacity is placed under the board on which the working parts are mounted, and is connected to binding-posts 2 and 3. The buzzer coils E are simply two coils wound in parallel, eight ohms each, one side of the windings of each coil being grounded on the frame at 8, and the other sides connected at 9. The circuit-breaker consists of a thin iron reed, fastened by a screw to the core of the left-hand coil, and supported in the middle by a brass rod, which passes through a vertical standard at 12, and is capable of being adjusted by the two antagonistic lock nuts. There is a particular note for working, best adapted to each condition of the line, and this note is obtained by changing the tension of the reed and altering the air-gap between the free end of the reed and the core of the right-hand coil. The two contact points at 10 are of platinum, and the pressure of the

stationary contact point is regulated by an adjusting screw, which also assists in changing the pitch of the note given by the buzzer. The circuits are shown in Fig. 8. The receiver is attached to 4 and 5, and the transmitter to 6 and 7. The switch A short-circuits the contact breaker; the switch B changes the connection from telegraph to telephone; switch C is used in changing from buzzer to ordinary Morse; switch D, when closed, puts one-half battery on the Morse circuit; coil F is an ordinary telephone induction coil. When in use for sending buzzer Morse A is open, B is on 15, C on 25, and D open. For ordinary Morse A is on 12, B on 15, C on 26, and D on 34. For telephoning, A is either open or closed, B on 14, C on 25 or 26, and D open. The battery, which consists of six dry cells, is connected with 30 and 31, the middle of battery with 32. The sending key is the ordinary telegraph key with an additional front contact 35, which is so adjusted that it will barely break when the key is up. When sending buzzer Morse the current passes through battery, key and coils to contact breaker, and thence back to battery. Each time the current is broken by vibrations of the reed at the contact points 10, the coils discharge at 8 and 9, and go through 16, and as the key is down to 23 and 29, through key to 35 and 36 and 4 to 2 and line, 1 being earthed. In receiving buzzer Morse the current passes through 2 to 4, through telephone receiver to 5, and back through 15 and 17 and coils to earth. In sending ordinary Morse the current is passing steadily from the battery to 30 and 34, through D to 33, to 28, through back contact of key to 29, and through coils as above, no buzz occurring as the vibrator is short-circuited. When the key is depressed the coils discharge, due to the break occurring at 28. This discharge goes to line as above, and gives a note in the receiver at the distant end. As the key is depressed, contact is made at 27, and current now passes from battery through 30 and 24, through C to 26, and through the resistance to 25 and 27, through the key to 29, and through the coils as above. The current is consequently weaker than before, and when the break occurs on the up stroke the sound in the distant receiver is less than on the down stroke; thus giving the same effect as with an ordinary sounder. The telephone circuits are the same as in an ordinary telephone. The condenser is used when it is desired to cut the kit in on a telegraph line or for phonoplex work.

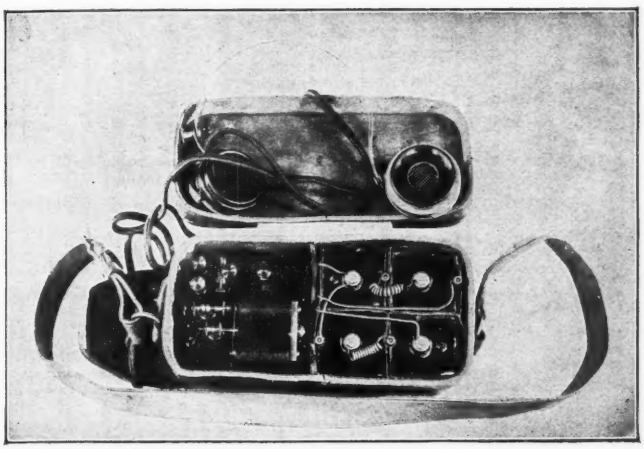


FIG. 9.—SIGNAL CORPS APPARATUS.

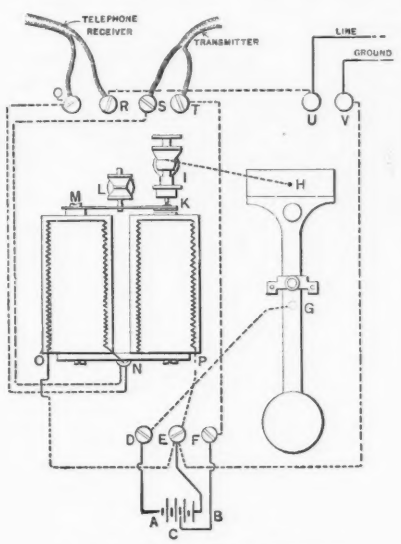


FIG. 10.—DIAGRAM OF CIRCUITS.

Type D, which is shown in Fig. 9, is a simplification of type C, and has proved invaluable in field service. It is enclosed in a leather case with straps, 6½ by 7½ by 4½ inches, and weighs about seven pounds. It is used for buzzer work and telephoning, and the circuits are indicated in Fig. 10.

The field telephone kit, as shown in Fig. 11, is contained in a strong wooden box 11 by 7 by 7 inches, weighing twelve pounds. This kit is supplied with a magneto call, combined receiver and transmitter, and dry battery. The combined receiver and transmitter consist of a transmitter of the Ericsson type, and watch-case receiver, which are connected by steel rods for strength; these steel rods form part of the circuit, and are partially covered by a wooden handle, containing a compression switch for controlling the battery circuit of the transmitter, which is supplied by two dry cells.

The cut-in telephone, as shown in Fig. 12, is used for cutting in on ordinary telegraph lines to talk between repair parties without interrupting telegraphic communication, and for outpost service in the vicinity of a telegraph line. The wiring of the kit is shown in Fig. 13. It is contained in a strong, wooden box, 6¾ by 5½ by 9¼ inches, weighing approximately eight pounds, and consists of a watch-case receiver R, of low resistance, a serrated metal plate P on the side of the box, a metal stylus S, coil C, which is wound to four ohms, whose core consists of soft iron wires projecting a couple of inches beyond the end, telephone transmitter T, battery switch B, four dry cells B-A, and a one-microfarad condenser. When not in use the watch-case receiver, stylus and the mouth-piece of the transmitter are fastened on the inside of the door. When the stylus is scraped on the serrated plate the coil is charged, and discharges to line, giving a harsh rattling note, which serves as a call in the distant receiver, and when answered, the transmitter is used by closing the switch in the battery circuit. In case the two parties who are communicating with each other are on opposite sides of a telegraph station, the instrument at the station is bridged by a condenser.

The field telephone switchboard, as shown in Fig. 14, is for ten lines, and is contained in a stout box, 15 by 9½ by 14½ inches, and weighs thirty-four pounds. The line binding-posts are on top of the box and protected by a hinged cover. The front and back are both hinged for easy access to the working parts, which are mounted on a hard rubber panel, countersunk in the front board, the bottom of which is recessed to hold the combined receiver and transmitter. The wiring of the board is shown in Fig. 15. The drops are of the high-resistance

tubular type, permanently bridged across the line. The first row of keys are ringing keys, and the next three rows are cross-connecting keys, while the three keys

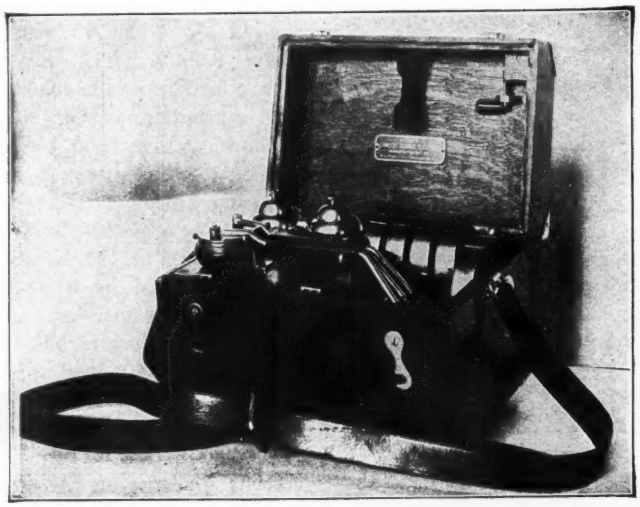


FIG. 11.—FIELD TELEPHONE KIT.

below the panel are listening keys, each being connected to a line of cross-connecting keys. Turning down any two cross-connecting keys in any row connects

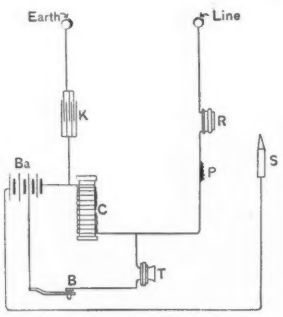


FIG. 13.—WIRING OF FIELD KIT.

these two lines. The listening key is bridged across the connecting strips in each row. The board is supplied with a magneto generator, and all the drops have the usual night bell attachment. Four dry cells are used, two each in series multiple. A strip of wood, faced with felt, is fastened to the rear face of the front door, in such a position as to keep the shutters of the drops from moving while the switchboard is being transported. This switchboard is very strongly and compactly made, so as to stand rough usage in the field without damage.

For small central stations, up to about forty lines, a compact type of switchboard is shown in Fig. 16. The 20-line board is 25 by 9¼ by 12 inches, and the 40-line is 25 by 9¼ by 20½ inches. All the working parts, except the magneto, which is fastened to the back of the board, are mounted on a hard rubber panel inserted in the front of the board, which is hinged to the backboard, at the bottom of which, protected by a hinged cover, are the line terminals. The whole board is designed so that all parts will be easy of access, and its wiring is that of the usual practice, the operator's set being a combined receiver and transmitter.

The field searchlight section consists of a generator truck, Fig. 18, and a projector truck, Fig. 19. The boiler is the cap coil water-tube boiler, and steams equally well with coal or wood. The engine is a 3″ by 3″ direct-connected to a G. E. M. P. 6-2.5-800, 80-volt generator. In the photograph these are shown encased in Russia iron to protect them from the weather, and are situated just behind the water tank in front, the capacity of which is sufficient for a two-hours' run. Above the generator is a cylindrical oil tank. On the shelf between the boiler and engine is located the field rheostat, which is enclosed in a weather-proof covering, and a space is left on the shelf for a voltmeter and ammeter when the generator is in service. This truck can be easily hauled by two horses, and weighs, with fuel and water for a two-hours' run, 5,300 pounds. The projector, which is the 18-inch type of the General Electric Company, with both hand and automatic control, is mounted on the rear platform of the projector truck, which weighs 3,000 pounds. Spring-supported in the centre of the truck is a box to carry the door and reflector, while the locker under the seat has compartments for 125 carbons, the voltmeter and ammeter and tools. Underneath the platform of the truck is the cable reel, which is fitted with contact rings, which are protected from the

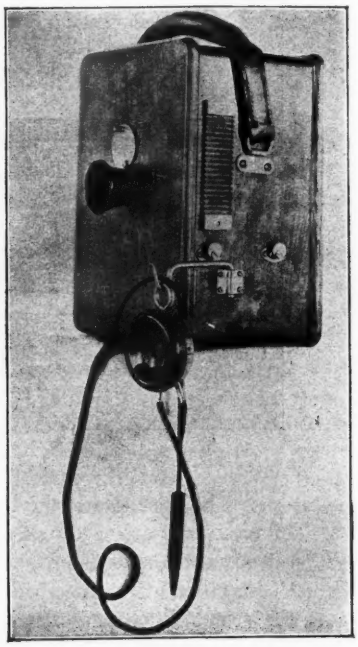


FIG. 12.—CUT IN TELEPHONE.

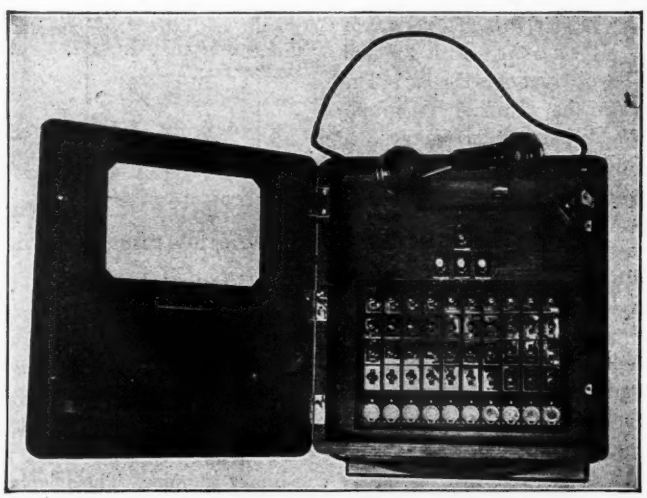


FIG. 14.—FIELD TELEPHONE SWITCHBOARD.

weather by brass housing. The cable itself is in one length of 1,000 feet, twin conductor, 0.77 ohm resistance, this resistance being sufficient to give the proper drop from the generator to the arc. The projector can be trained 360 degrees in azimuth, and from thirty below to seventy above the horizontal. The projector is furnished with a radial shutter for signaling purposes, which slips as a hood over the door. This shutter consists of sixteen over-lapping radial leaves, each one pivoted at its inner end in the central hub, and at the outer end in the frame. The inner ends are so connected in the hub that by partially revolving it by a lever from the side, the edges of the shutter are turned in the direction of the beam. The hub is spring-controlled, and the tension of the spring keeps the leaves of the shutter normally closed. By opening and closing the shutter, short and long flashes of light, corresponding to the dots and dashes of the Morse code, can be sent and signals exchanged at night for long distances. Messages can be frequently exchanged from distant stations, which are not intervisible, by throwing the beam on the clouds.

The material for constructing and operating the flying telegraph line is carried in the field telegraph train, which consists of three telegraph sections and a field searchlight section, which has been described above. Each telegraph section contains material for the erection of from fifteen to seventeen miles of line, and consists of a wire wagon and a lance truck. The lance truck contains 500 lances, twenty lance butts, hard rubber insulators, and the necessary digging bars and tools. The wire wagon contains twenty miles of wire, both bare and insulated, reels, line-construction tools, etc., several sets of instruments and stationery necessary for operating an office. Attached to the telegraph train is the battery wagon, which is equipped with a sufficient number of cells of the Eagle, Edison-Leland, or storage type, to operate the lines. Battery is used at one end of the field lines alone. This wagon also carries the various types of field apparatus, serving as a central office for the system that is erected by the train.

The lances are of well-seasoned cypress or spruce, 14 feet long, 2 inches at the butt, and 1½ inches at the top, the lower end being pointed. The lance is tipped with a malleable iron ferule with a screw socket for fastening the insulator, which is of hard rubber or gutta-percha, moulded on a standard that screws in the ferule. The insulators are of two kinds: slot and "pig-tail." In the slot insulator the top is channeled for a depth of one-half inch to allow the wire to slip through it, and is supplied with a pin

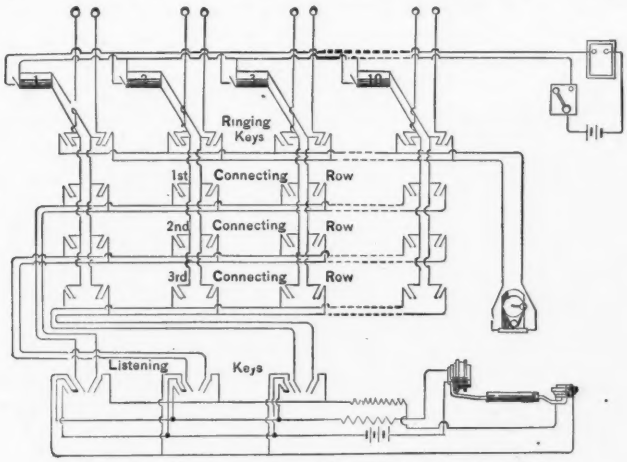


FIG. 15.—WIRING OF FIELD TELEPHONE SWITCHBOARD.

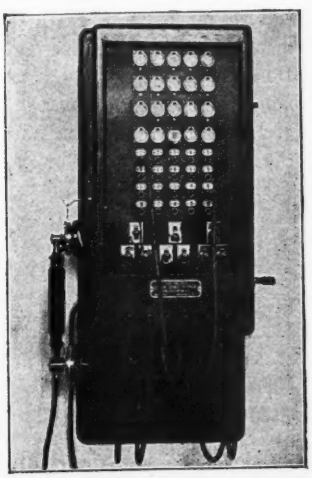


FIG. 16.—SMALL SWITCHBOARD.

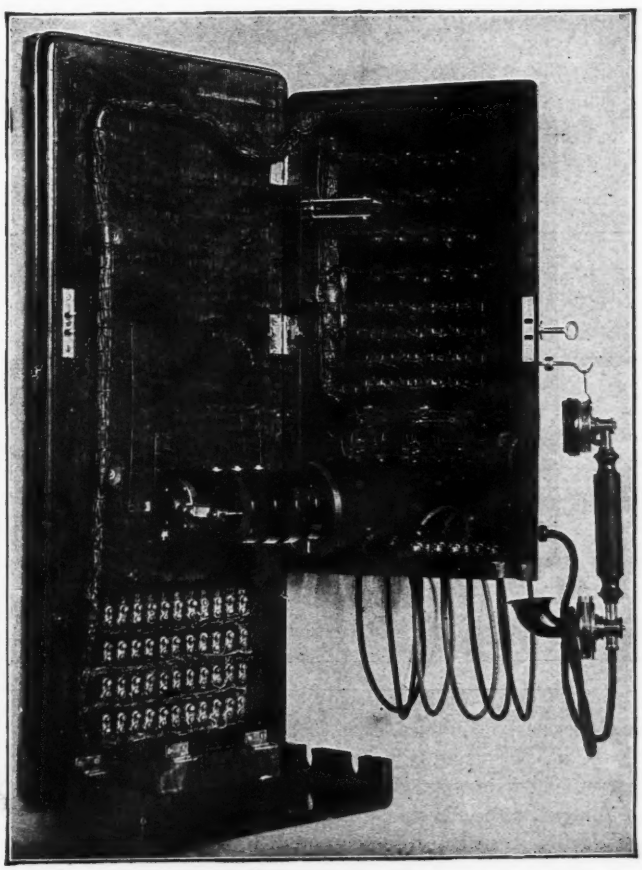


FIG. 17.—FIELD TELEPHONE SET.

to prevent the wire from rising out of the slot after being placed therein. In the "pig-tail" insulator an additional iron piece in the shape of an S is moulded in the top. This "pig-tail" is used to keep the tension on the line by tying the wire around it. In constructing the line approximately every third insulator is of the "pig-tail" type.

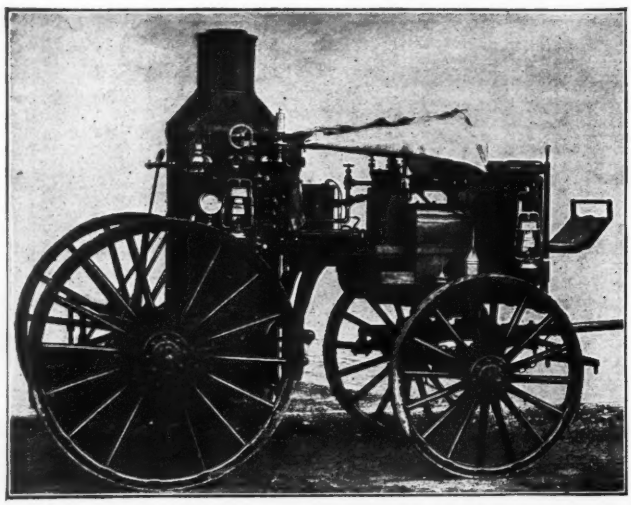


FIG. 18.—GENERATOR TRUCK, FIELD SEARCHLIGHT.

In constructing the field line, after a preliminary reconnaissance has been made, the location of the lances is fixed by pins marking their position, the distance between the lances being from fifty to sixty yards. A working party equipped with crowbars sink the holes, from two to two and one-half feet in depth, according to the nature of the soil, and following this working party is the lance truck, which distributes the lances along the ground. The wire is then paid out from the wire wagon, following the lance line. The wire is slipped into the slot insulators or tied to the "pig-tail" insulators, the lances then raised and inserted in the holes and tamped. When it is necessary to cross roads the lances are lengthened by a butt joint, which is of the same material as the lance, ten feet long and two and one-half inches in diameter, to which the lance is fastened by suitable clamps. In favorable ground a speed of three miles an hour has been obtained in erecting a line in actual service. As the advance continues the field telegraph train is followed by permanent construction parties, which erect either permanent or semi-permanent lines, depending upon the nature of the communication required. The maintenance of lines, especially when operating in an enemy's country, is the most difficult, trying and dangerous operation connected with field communication.

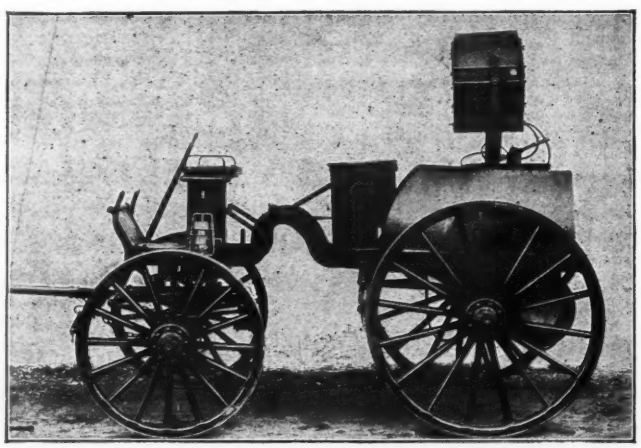


FIG. 19.—SEARCHLIGHT PROTECTOR TRUCK.

For fortress service the most important system of communication is that for fire control. Fire control is the system by which the officer known as fire control commander directs the fire of the separate batteries under his command. The combination of two or more fire control commands constitutes a fortress. The charge of communication is as follows: The fortress commander is connected with each fire control command, each fire control command with the position-finding stations of the batteries constituting it, and each battery position-finding station with the guns of the battery. The unit in fire control is a battery, which contains from two to five guns, varying in type from the twelve-inch to the small rapid-fire guns for the defence of the mine field. Each battery has a position-finding station, from which the range and azimuth of the targets are obtained. There are two general systems for determining this: the vertical and horizontal base systems. In the vertical base system the range and azimuth are obtained by direct observation with a range-finder, and in the horizontal base system by simultaneous observations from the two ends of the base line, the observed azimuths being communicated to a plotting room, where they are laid down on a specially prepared map, and the range and azimuth of the target determined. After this data have been obtained, by either system, it must be communicated from the battery commander station to the guns, as well as certain tactical data as to the kind of shot or shell to be used, etc. As yet, neither our own nor any of the foreign governments has reached a completely satisfactory solution of this problem. A number of devices have been tried: the telegraph is too slow, and requires skilled operators; the various systems of step-by-step printing telegraph are likewise too slow, and are easily thrown out of adjustment by the shock of firing; the telephone is unreliable as the transmitter is packed by the effect of the blast, and is uncertain, since in transmitting figures by speech, especially in the excitement of an engagement, mistakes are frequently made. The system that will successfully solve this problem must be simple in construction, mechanically strong so as not to be affected by the blast as the receivers are placed close to the guns, rapid in operation, and give a character of record that can be read without liability of error. The communication from the station of the fortress commander to the fire control commanders is comparatively simple, as, owing to their location and the character of the messages which are exchanged, the telephone has proved satisfactory, but the line of communication from the fire control commander to the guns is the one in which the difficulties have occurred. The development of a suitable system is urgently needed, and it is hoped that its solution will be achieved by the engineering profession, as upon the successful working of the fire control communication depends the efficiency of the defence of our seacoast cities.

Apparatus for X-Light Diagnosis—I.

Being a Continuation of Notes on X-Light.

By William Rollins.

NOTE CXXXIX—NON-RADIABLE CASES FOR X-LIGHT TUBES.

Experiments have already been reported which proved that X-light could make animals blind and kill them. Therefore, it is a dangerous agent to use without proper precautions. Some of these have been mentioned at different times, but as they are being constantly neglected they will be stated again in a group.

First—The X-light tube should always be used in a non-radiable case from which no X-light can escape except the smallest cone of rays which will cover the area to be examined, treated or photographed.

Second—The fluorescent screen should be covered on the side nearest the eyes with a sheet of heavy lead glass one centimetre thick, because the fluorescent salt allows much of the X-light to pass through it unchanged.

Third—All parts of the fluoroscope, except the screen, should be heavily painted with non-radiable paint.

Fourth—The physician should wear spectacles of lead glass one centimetre thick.

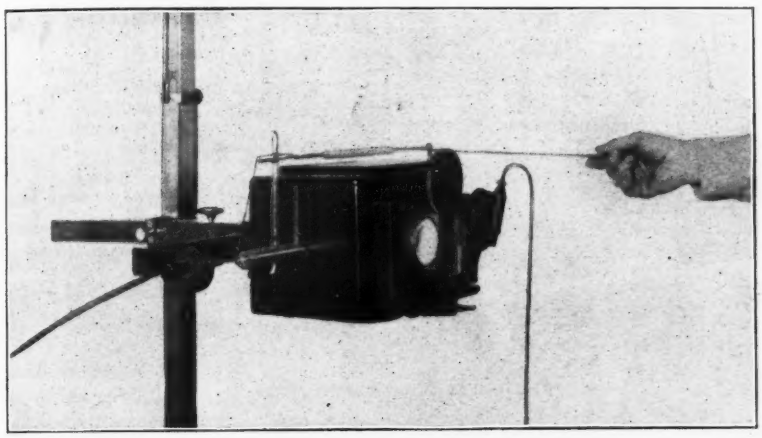


FIG. 1.—SEMI-ENCLOSED BOX FOR X-LIGHT TUBE.

NON-RADIABLE CASES FOR X-LIGHT TUBES.

It seems hopeless even at this late date, when we know so much about the possibilities of injury from X-light, to get others to use an X-light tube entirely enclosed in a non-radiable case, because of the supposed inconvenience of so large a box, therefore the type shown in the Figs. 1 and 2, is of the semi-enclosing type, being a modification evolved by experimenting with the one shown in note xxxvi, August 17, 1898. The case is of the proper size for the tube illustrated in note cxxxviii.

The front is polished glass, three centimetres thick, to allow the tube to be examined by light of ordinary wave length to which the glass is transparent, though it absorbs the X-light on account of the great number of subatoms crowded into the atoms of lead of which the glass is largely composed. As it is desirable always to have the glass front toward the observer, there is a hole in the top and another in the bottom of the case for X-light to escape through when it is desired to place a patient in a horizontal position with the tube above or below him. When not in use the holes are covered with non-radiable slides. The criticism was made that these glass fronts would be too expensive, therefore in a later note (xciv) a box without glass was illustrated which entirely enclosed the tube. Continued experience during five years of experimental work with powerful apparatus has shown that the glass front is so convenient as to

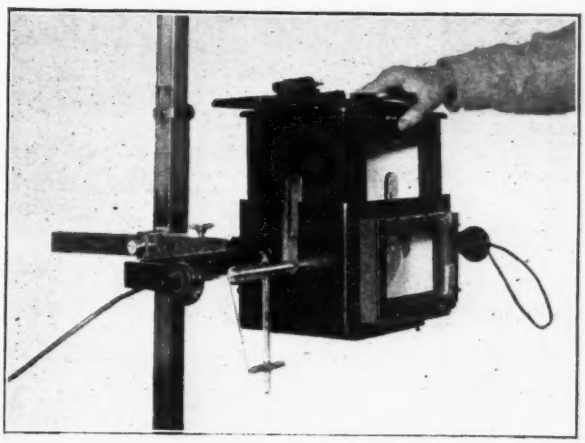


FIG. 2.—SHOWING THE TOP BEING REMOVED.

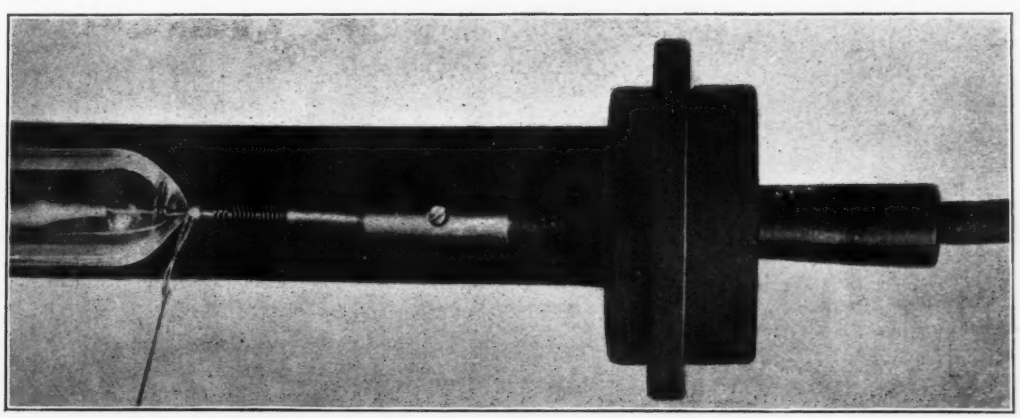


FIG. 3.—SHOWING INSULATING COLLAR AND SPIRAL SPRING CONNECTION.

outweigh the cost, about $5; therefore it is used in the tube case shown in Figs. 1 and 2. The whole case is coated on the inside with a non-radiable paint, white lead in japan, which dries so quickly that six coats can be put on in a day. The test of the number required is to expose a photographic plate in contact with the outside of the case. If the plate is not fogged in seven minutes the coating is sufficient.

The tube case should slide on a vertical support through a range of 170 centimetres. It should have a horizontal movement of one metre; there should be a joint to allow the tube case to be moved in a vertical arc whose plane is parallel with the long axis of the tube, and another which will allow a similar movement in a plane parallel with the short axis of the tube. These movements are essential, for the axis of the central ray of the cone of X-light escaping from the case must always be normal to the plane of the photographic plate or fluorescent screen, otherwise there will be distortion of the image. The great importance of these movements in a vertical arc is well shown in the illustrations.

The tube box is in two parts, one telescoping into the other. In Fig. 2 the top is being removed. This construction utilizes the weight of the top piece to hold the tube from moving. The two pieces have slots in each end that allow free passage to the ends of the tube. The slots are lined with soft rubber to furnish cushions for the ends of the tube to rest on. The wires leading from the generator are held in insulating collars which are shown in Figs. 1, 2, 3.

On the ends of the leading wires are spiral springs of piano wire which slide loosely over the terminal wires of the ends of the tube (Fig. 3).

At the present time it is practical to make instantaneous pictures of the moving organs in the human chest, provided Pupin's idea of employing a fluorescent screen in contact with the photographic plate is used. A sheet of celluloid* coated with photographic emulsion is better than a glass plate, as this allows two or more fluorescent screens to be used. A single screen allows part of the X-light to pass through unchanged. A single screen makes the development image blotchy. More than

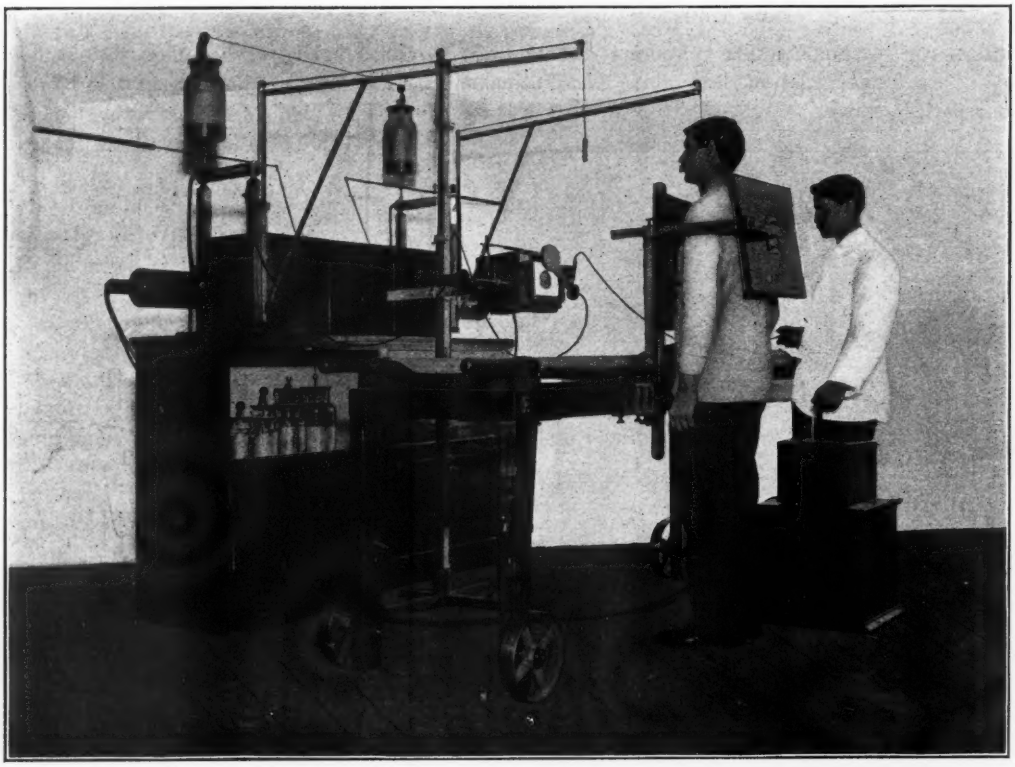


FIG. 4.—PHOTOGRAPHING PATIENT'S CHEST IN UPRIGHT POSITION

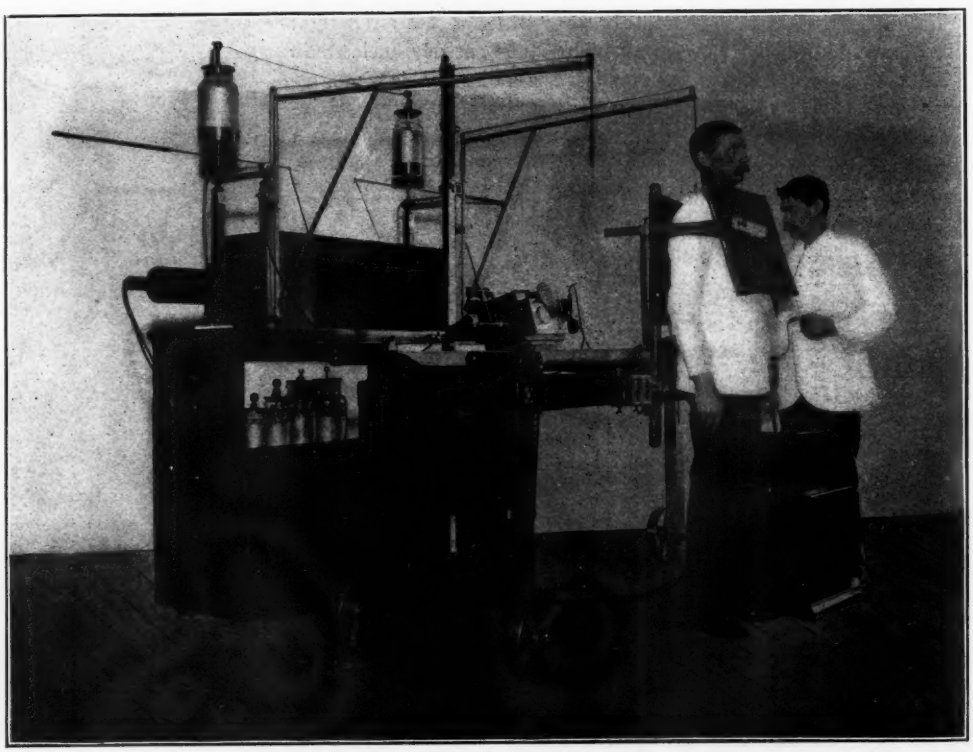


FIG. 5.—PHOTOGRAPHING PATIENT'S CHEST IN UPRIGHT POSITION.

* *International Dental Journal*, 1896.

one screen is therefore better because the time of exposure is shorter and the blotches are less apparent, for the bright places on one screen usually correspond to darker places on the others. All screens, however, blur the image and should only be used where fine detail is not required. A tube often needs a little preparation to get the light best suited for an instantaneous exposure; therefore a tube case needs an instantaneous shutter, for in this way after the tube is in the proper condition the shutter can be closed while the photographic plate is put in place, then by pressing and releasing a bulb the shutter is opened, the plate exposed to the most suitable radiation and the shutter closed. The tube case is provided with two of these shutters, one of which can be attached to either the top (Fig. 2) or the bottom of the tube case. The second is used on the front of the tube case when it is desirable to photograph a patient's chest in an upright position, Figs. 4 and 5.

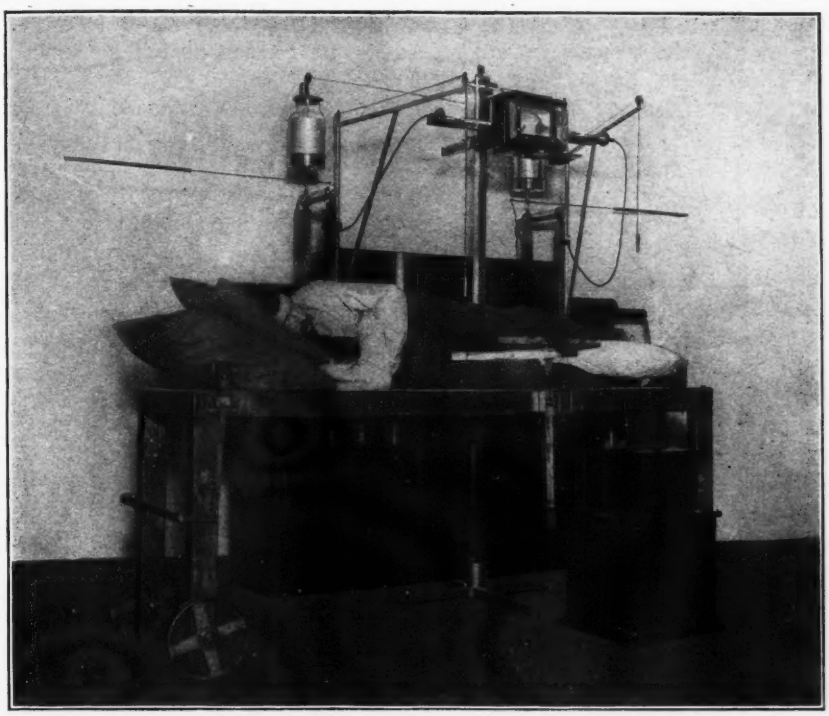


FIG. 5½.—SHOWING POSITION OF APPARATUS IN PHOTOGRAPHING LIMB.

The tube case, therefore, has two glass fronts, one of solid glass, Fig. 2, to act simply as a window, the other with a hole in the middle, as shown in Fig. 1, for the escape of the required cone of X-light. This hole is covered by the shutter when the X-light is to be cut off. With the shutter over the opening the tube can still be seen through the glass around it.

The form of shutter chosen for illustration is a simple one, because the object is to call attention to a principle which, as the power of X-light apparatus increases, will come into use. Better shutters might have been selected, for any of the many beautiful ones used in ordinary photography will answer if made of non-conducting and non-radiable material. The one here illustrated is of wood pivoted on a wooden pin and operated by a rubber bulb held in the hand, air being forced in and drawn out of a hard rubber cylinder, whose piston, of the same material, is attached to the shutter. The shutter should lap over the largest opening in the tube case about fifteen millimetres (five-eighths of an inch) to prevent the escape of X-light. It should be lined with white lead in japan until non-radiable. The edges of the hole in the tube box should be coated in the same way on the side next the shutter.

In all the illustrations the tube is placed with the radiant area on the target at one metre (thirty-nine inches) from the photographic plate or fluoroscope. This is a good standard distance. It is of some importance to have a standard distance, as then the eye gets accustomed to definite sizes of images of the human organs.

In this way a variation in size that is abnormal is more easily detected. Apparatus which requires a less distance than one metre between the target and the photographic plate is not satisfactory.

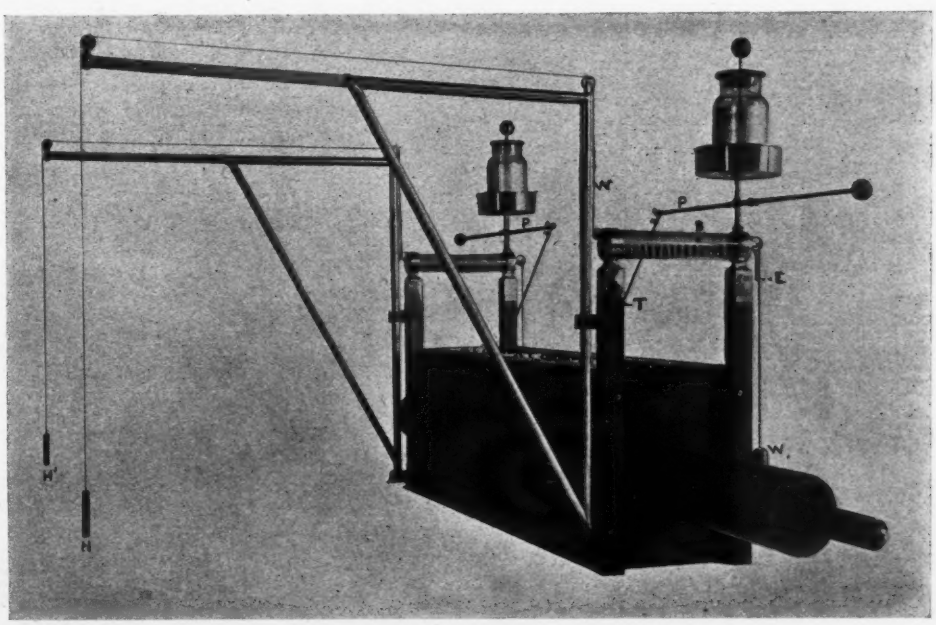


FIG. 6.—SEVENTY-ONE-CENTIMETRE COIL.

NOTE CXL—SOME OTHER APPARATUS NEEDED IN THE MEDICAL APPLICATIONS OF X-LIGHT.

The coil as arranged in the illustrations to note cxxxvii was not intended par-

ticularly for medical use, therefore in the present note the necessary changes will be described and illustrated.

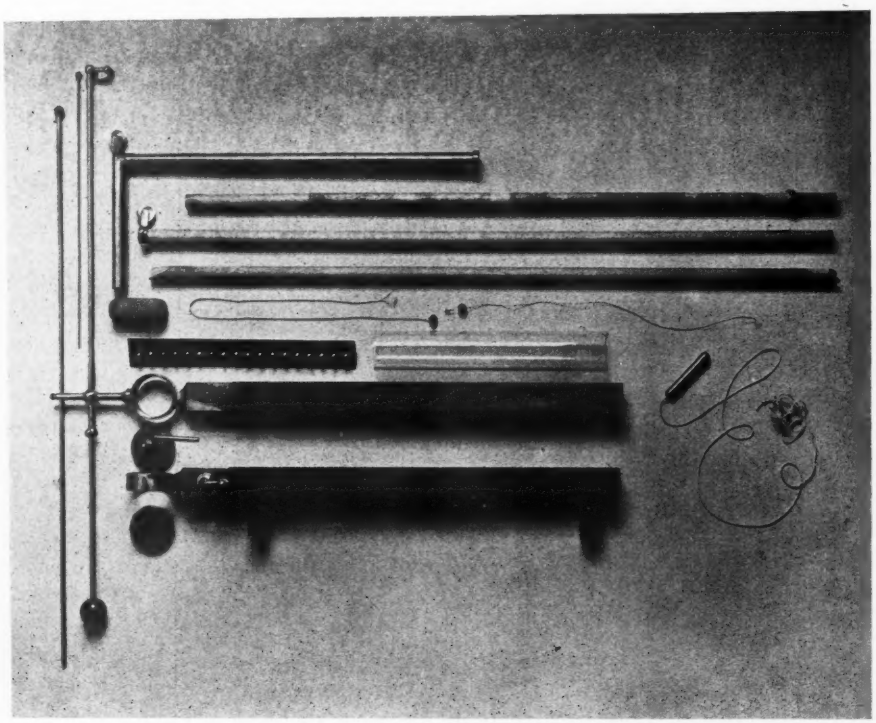


FIG. 7.—DETAILS OF SEVENTY-ONE-CENTIMETRE COIL.

ARRANGEMENTS OF SPARK-GAPS.

In examining a patient by X-light it is of prime importance to have the light under the control of the physician without his removing his eyes from the fluoroscope. (Note cxii.) This requires mechanism by which the spark-gaps can be controlled at a distance from the coil. Dr. Williams did this with a large static machine by bringing cords over pulleys attached to the ceiling. The plan shown here is a mechanical modification of his idea to adapt it to a coil and make the apparatus portable. Fig. 6 shows a seventy-one-centimetre (twenty-eight-inch) coil with suitable spark-gaps for medical use. The details of a spark-gap, when this is taken apart for transportation, are shown in Fig. 7. The handles (hand H', Fig. 6) are within easy reach of the physician's hands while he is examining a patient. (Fig. 8.) The distance of these handles from the coil may be varied by sliding the rods more or less into the hollow angle sockets. The rods forming the spark-gap controlling mechanism are ordinary birch dowels three quarters of an inch in diameter which can be bought for one cent each. The supporting arms swing in arcs whose planes are horizontal.

There is a piece of wire cable (W), Fig. 6, which brings the current from the brass ball (B) to the brass cap forming the front of the glass spark-gap tube. To this cap is attached the socket (T) into which the cable going to the X-light tube is inserted.

To counterpoise the weight of the cord and handles a counterweight (W) is attached to the brass ball (B) by oiled silk fish-line. Otherwise the mechanism of the spark-gap is that described in note cxii which should be consulted. E is a tube connected with an aspirator to remove the nitrogen compounds produced at the spark-gaps.*

Figs. 9, 10 and 11 show the spark-gaps in use while photographing a patient in different positions.

EXAMINATION TABLE.

This is a simpler form of the one illustrated March 9, 1901. The table (Figs. 5½, 9, 10 and 11) moves on large wheels to allow any part of a patient to be easily brought between the physician's eyes and the X-light tube, while he remains in proper position to control the light by means of the break and spark-gaps. This examination table is provided with a canvas stretcher because it has been clearly shown by Williams that examinations can be made on the same stretcher that is employed at the Boston City Hospital to bring the patient from the wards to the X-light laboratory. Instead, however, of

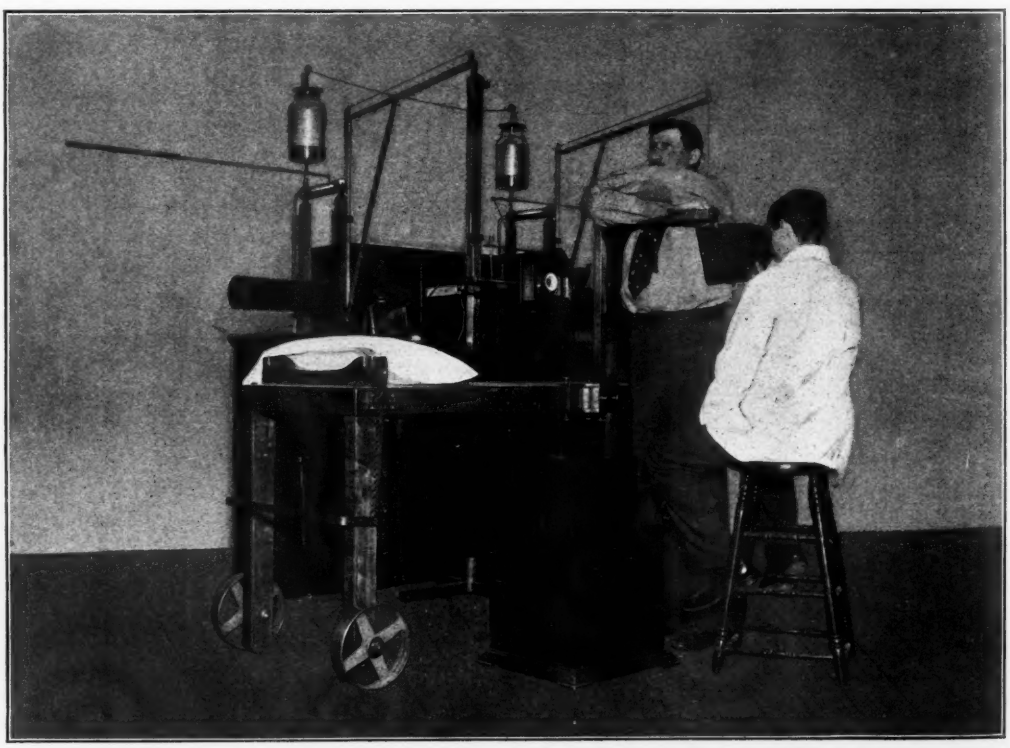


FIG. 8.—EXAMINATION, X-LIGHT PHOTOGRAPHS.

* *Boston Medical and Surgical Journal*, April 25, 1901.

using the stretcher on fixed supports, it is best to attach it to a rolling table for the reasons given. Fig. 9 is a general view of the apparatus used with a seventy-one-centimetre coil whose spark-gaps (Fig. 6) are arranged for medical work. The patient is in position for photographing a stone in the bladder. For this procedure the patient's feet should be higher than his head that the stone may fall away from the pelvis. (Note cxvii.) One end of the stretcher is therefore raised by means of toothed bars pivoted to the ends of a notched bar holding the ends of the stretcher poles. The canvas is slack, for this allows the abdomen to be more pendent. In those cases, where a slack canvas is undesirable, it can be made taut by turning one of the bars supporting the canvas, a ratchet holding the bar from turning back. When it is desired to bring the patient to a horizontal position the bar connecting the two toothed bars is pressed, to release the toothed bars, while the stretcher bar-handles are firmly grasped. This mechanism allows the movement to be made by one man. The stretcher can be entirely removed, the thin top of the table serving as a support for a patient in a sitting position (Fig. 10) or while reclining. (Fig. 11.)

Fig. 11½ shows a convenient support for use in connection with the examination table.

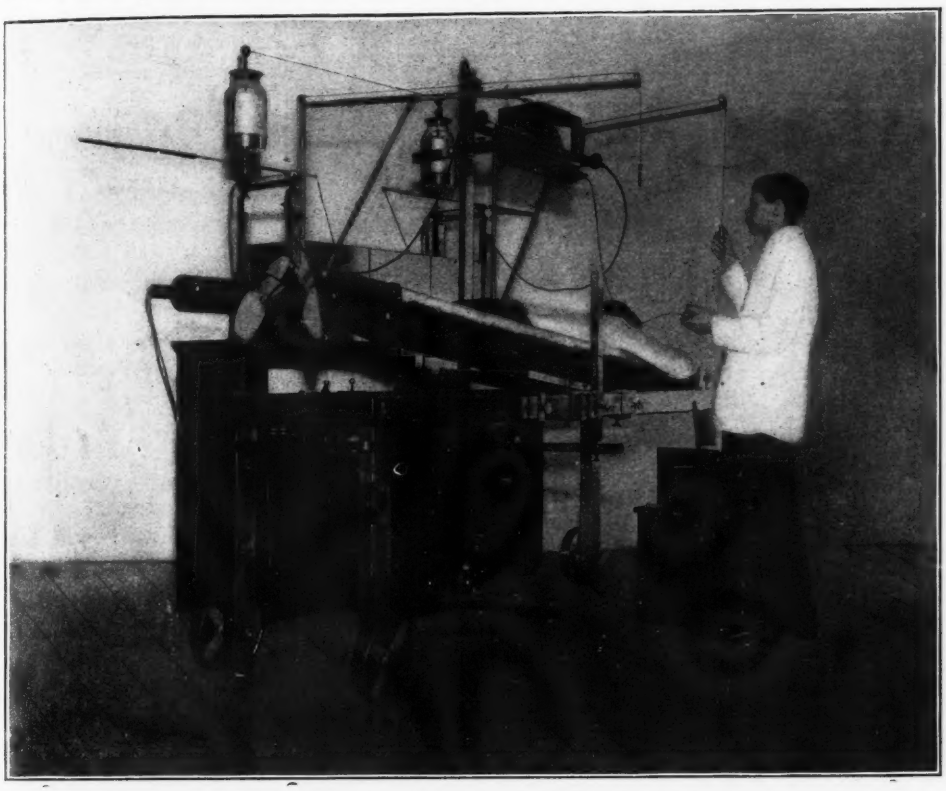


FIG. 9.—PHOTOGRAPHING IN RECUMBENT POSITION.

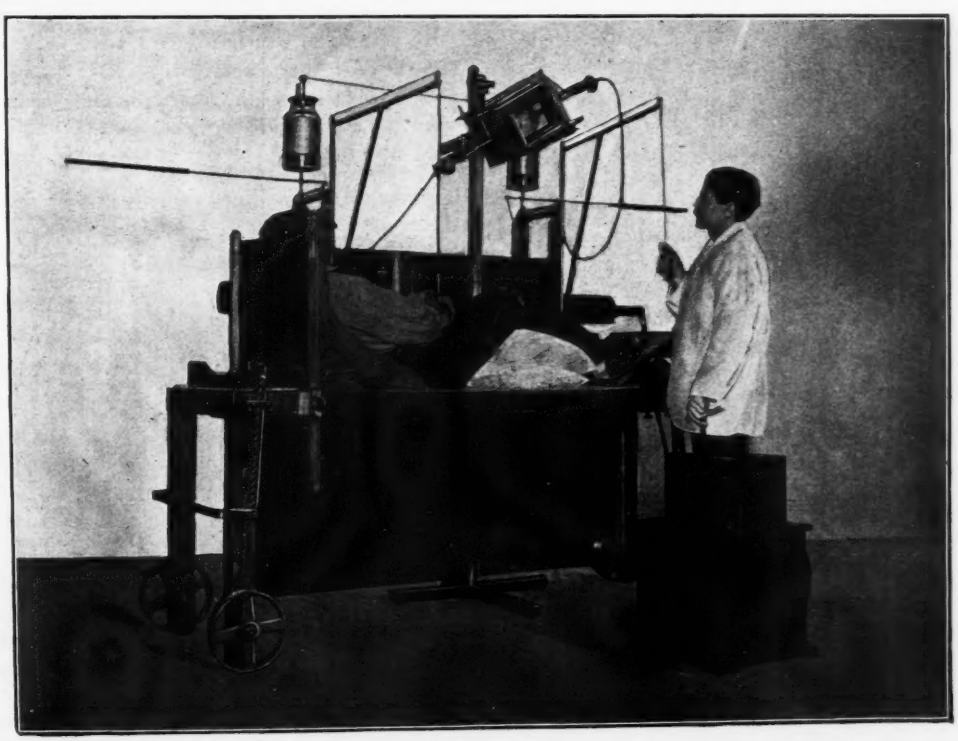


FIG. 10.—PHOTOGRAPHING PATIENT'S FEET.

WHAT IMPROVEMENT IS DESIRED IN METERS?*

BY ROBERT FERRIS, CLIFFORD A. WHITE AND H. H. SCOTT.

ROBERT FERRIS.

Considering the improvements in meters during the last few years it may be reasonable to expect still further improvements along this line. Perhaps the greatest improvement would be that which would eliminate the possibility of a meter's being stopped when it should be in motion. The success of a meter depends largely upon the friction of all moving parts being reduced to a minimum. Anything that would replace to advantage the pivot and jewel, without sacrifice, would be an improvement; for if we can keep a meter in motion it should be easy enough to keep it in calibration.

The efficiency of meters is something of importance, yet a meter should have plenty of torque. While it is possible to save considerable by having efficient meters, it is also possible to lose considerably more by having meters that will not stand up on light loads.

Durability, then, is another

*Read before the National Electric Light Association at its twenty-fifth convention held at Cincinnati, Ohio, May 20, 21 and 22, 1902.

consideration, which with reference to meters means that a meter can be put in service and remain there without additional cost, whether in the shape of attention, repairs or loss of revenue.

It is rather hard to say just what improvement is most desired in meters, for we find ourselves pitted against the engineering forces of all the manufacturers, and it is known that there are many who are trying to make a living trying to produce that improvement. A few suggestions might be made that would at least furnish something for the engineers to work on, and after submitting mine I should be glad if I could know that I was forgiven. They are: A universal meter in size and style; a backboard for meters, of a standard pattern, which could be adapted to meters of any make on the market; a registering dial that would read directly in dollars and cents, or if not that, then the adoption as a standard of direct-reading dials and a simple tell-tale hand on clock for calibrating purposes; a meter that would take the place of the combination of watt and discount meters, having the effect of registering at different rates of speed, which would be governed by the load that was passing. To illustrate: If we had, say, a 100-volt wattmeter of twenty-five-ampere capacity, instead of showing a straight line from five per cent of its capacity to full load, the meter speed would represent at full load accurate registering, and as the load dropped the proportional rate of registering would be a certain per cent slow or fast.

If it were wanted to increase the hours of lighting on a twenty-four-hour service, the first method would apply; and in the stations where only night service is given and it is wanted to increase the quantity of lighting for short hours, the latter would apply. Of course the reading would not show the actual watt-hours consumed, but that need not be a serious objection. The reading could be called units and the price would be so much per unit, and instead of discounting bills, we should find that the meter had already taken care of that.

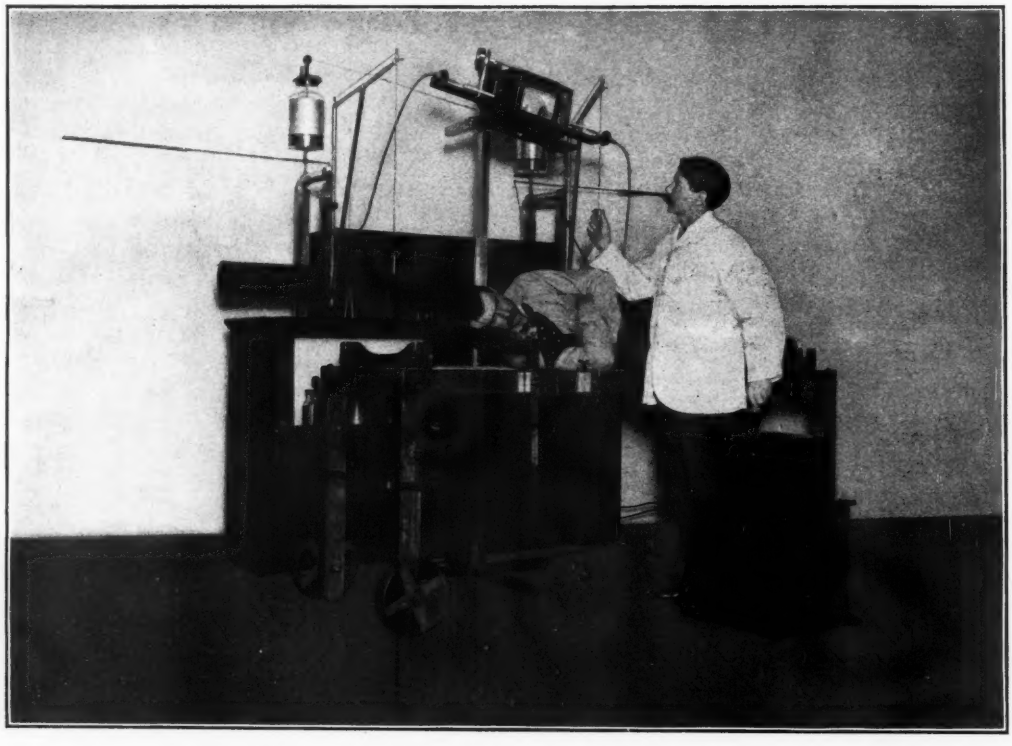


FIG. 11.—EXAMINATION TABLE, X-LIGHT PHOTOGRAPHY.

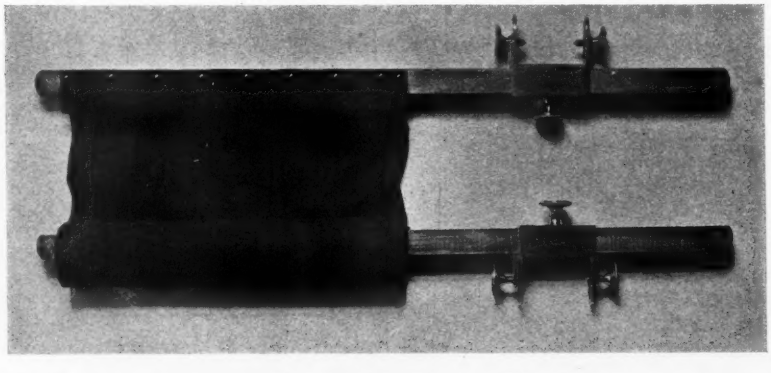


FIG. 11¼.—SUPPORT FOR EXAMINATION TABLE IN X-LIGHT PHOTOGRAPHY.

CLIFFORD A. WHITE—(*Abstract*).

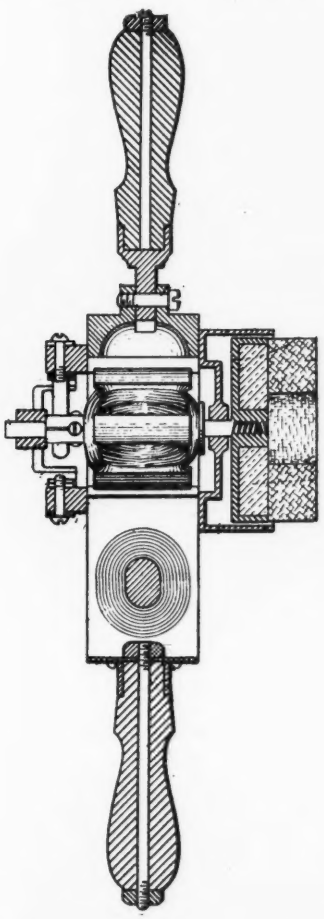
The meter dial should read direct in kilowatt-hours, thereby eliminating the use of the constant and the use of two terms, kilowatt-hour and watt-hour; there should also be a hand on the dial for testing purposes.

The term kilowatt-hour is not easily explained understandingly, but as this is the most appropriate and generally accepted unit of electrical energy it would be highly impracticable to adopt any other term, and the public must be educated to its meaning.

Nearly all meters now in use register in watt-hours, thus making necessary the use of two terms, which is confusing to the uninitiated. The average price for current is twenty cents per kilowatt-hour, which will continually grow less rather than more; therefore the kilowatt-hour should be the unit to use, as by adopting the rule of reading in every case the figures the hand has passed on the unit dial, the error in reading would never amount to more than ten cents to the customer, and the total sales of the company would not be affected at all. The new meters now being placed on the market register in watt-hours, which is a great improvement over those that required the use of a constant; but a direct-reading dial should be designed to replace those now in service having constants. This does not seem a mechanical impossibility, and if the cost were reasonable it would be generally adopted. The constant has always been a perpetual source of annoyance and error. Its use makes a great deal more work in the bookkeeping department, and complicates the rendering of bills correctly.

Electrical Patents

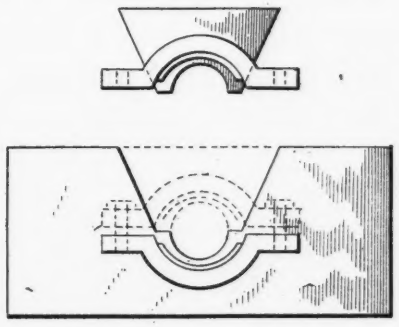
A simple burnishing or polishing machine has been recently invented by Orrin A. Hanford, of Woburn, Mass., who has sold his interest in the patent obtained thereon to Charles A. Gridley and George Barnhardt, of Boston. The machine is driven by electricity, and an ordinary motor is employed, comprising field magnets connected by a core, around which is wrapped the usual field coils. The ends of these magnets are connected by insulating strips or blocks, and to



An Improved Electrical Burnishing Device.

these strips or blocks are attached suitable handles, one of the handles being pivoted. The armature is journaled between the field magnets, the brushes being located at one end of the shaft, while the buffing or polishing pad is secured to the other end in any desired manner. This pad projects from a casing secured to the magnets and completely protecting the parts of the motor from the dirt thrown off by the polisher.

A new outlet box of novel construction has been patented by Mr. Hubert Krantz, of Brooklyn, N. Y. In this instance the box is provided with a cutout portion, the lower end of which is rounded and has an outstanding flange, provided at its ends with projecting ears. A block is detachably fitted in the cutout portion, and has a semi-circular recess in its lower end and an outstanding semi-circular flange provided with terminal ears arranged to be placed upon the ears of the other flange, thus forming, when the parts are together, an outstanding neck, the ears are secured together by suitable bolts passed through the openings therein. The neck formed by the semi-circular flanges can be internally screw-threaded, if desired, or it may be smooth. In a modified form of construction proposed by Mr. Krantz, the block completely fills



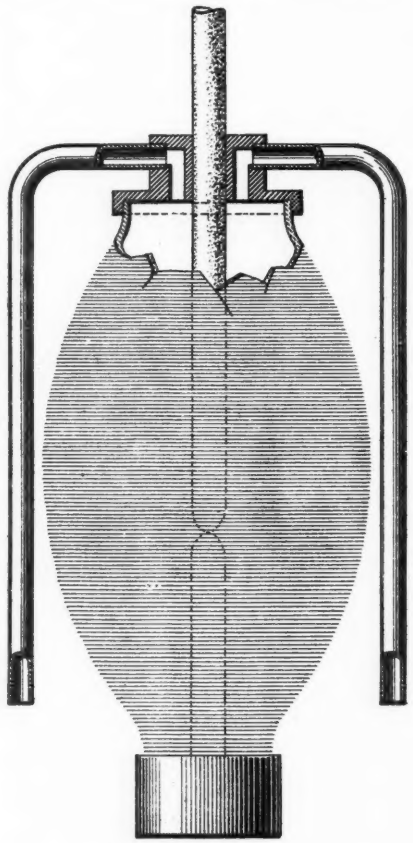
Improved Outlet Box.

the cutout portion of the box and is provided in its lower end with a circular opening, the semi-circular flanges above described being still employed.

Mr. Robert Hopfelt, a resident of Berlin, Germany, has been experimenting with different carbides, as, for example, calcium carbide to be used in electric arc lamps. He declares that a much more powerful arc is obtained than by the ordinary carbon electrodes. The difficulty, however, has been that carbides could not be used because they will be decomposed by the moisture in the atmosphere. He has overcome this objection, however, and has obtained a patent in this country on the improvements. The object of his invention is to so construct carbide electrodes for arc lamps that they will not be affected by the moisture in the atmosphere, and, accordingly, the electrodes will be as durable as, or more durable than, carbon electrodes now in use. This object is attained by covering the surface of the carbide electrodes with a layer impervious to moisture. Such layer or envelope may consist of certain metals or of a thin layer of varnish or cement or of vitreous coatings, etc. The covering may be advantageously produced by applying metal in the form of powder, metal salts or metalloid salts, with an organic cement or like binding substance to the electrodes and then burning them in a furnace. By this burning process the binding substance is first of all driven off and then the metals or metal salts melt and cover the electrodes at their surface with a close-fitting impervious layer. The envelopes which are employed with ordinary electrodes have quite a different purpose, as these latter are intended merely to increase the conductibility or to color the light, so that the quality of keeping off the moisture need not necessarily be present, while the envelopes here described are for the purpose of protecting the carbide electrodes against the decomposing action of the moisture in the air. Protracted experiments have shown that this can also be effected by surrounding the electrodes with a protecting metal envelope, which is advantageously drawn by mechanical means over the electrodes after the completed production of the electrodes—that is, after the same have been burned in the kiln. The metals which are employed with ordinary carbon electrodes—as, for instance, copper—can not be used for such carbide electrodes, as in the first place, their melting point is much too high, and, in the second place, such metals, particularly copper with carbide, at the slightest entrance of moisture effect an explosion of the acetylene developed, so that the electrodes burst apart. It is advantageous to employ only such metals as have a melting point under 1,050 degrees centigrade. The temperature which forms in the crater of the carbide electrodes is apparently so low that if, for example, iron or even copper or nickel were employed as a covering for carbide electrodes these absolutely would not melt, whereas these metals immediately evaporate when they are laid around carbon electrodes. Apparently a much higher temperature is generated in this arc flame than in the crater. It has been shown that tin, zinc, magnesium, brass, or, above all, aluminum can be advantageously employed for the moisture protecting coating. The destructive influence of the air on the carbide electrodes can also be guarded against by covering these electrodes with a thin layer of a varnish or a solid cement. The solvent, as well as the organic constituents of the varnish, must be so constituted that the same do not produce a sooty flame in the light arc, as the reflector, which is necessary for uniform radiation of light, would then become blackened and the intensity of the light considerably diminished. Therefore thick alcoholoids—for

example, glycerine—may be advantageously employed, the carbide electrodes being dipped in glycerine or covered with a cement which is mixed with glycerine. In the first case the carbide is dissolved at the surface by the glycerine and converted into gas and lime. The mass of lime, in consequence of the separation of the solvent, then surrounds the carbide in such an impervious layer that the moisture of the air is absolutely innocuous. The glycerine evaporates or burns completely in the flame arc with a bright flame without depositing even the slightest layer of soot. If it is desired to cover the pieces of carbide with a cement, any metal oxides may be dissolved beforehand in glycerine, some carbon being advantageously mixed, so that the coating itself will become conductive of current. Such a coating hardens after a short time and also protects the carbide against moisture without producing any injurious influences in the light while burning. Instead of glycerine, other alcohols or alcoholoids can be employed.

The Stanley Electric Manufacturing Company of New Jersey has purchased a patent recently issued to Messrs. Julius Auerbach and Frank Gubing, both of New York city, on an electric arc lamp. This invention relates to electric arc lamps of that class in which the arc is burned in a comparatively small transparent or translucent globe constructed to be substantially air-tight to avoid the free access of atmospheric air to the arc for the purpose of securing slow consumption of the electrodes and consequent long life of the carbons. The object of the invention is to promote the desired conditions of such lamps—that is to say, to provide a construction which will afford slower consumption of the electrodes than heretofore experienced, and consequently produce a lamp which will burn for a greater length of time without renewal of the electrodes. As is well known, in the operation of these lamps, gas is generated inside of the globe by the combustion or disintegration of the electrodes, and the problem is to provide a construction which will permit of the free escape of these gases and at the same time prevent the entrance of the atmosphere to the globe. To accomplish this, it has been the practice heretofore to either utilize the opening through which the movable electrode penetrates the globe or an entirely separate opening which is controlled by a mechanical valve. In either of these constructions the internal pressure of gases is relied upon to prevent the entrance of air, it being assumed that as long as the pressure inside is in excess of the pressure outside the air will to a great extent be excluded. In addition to this, however, in the second instance, that of the passage controlled by the mechanical valve, the passage is supposed to be held closed to the atmosphere until the internal pressure exceeds that of the atmosphere, whereupon the internal pressure lifts or opens the valve and allows the internal pressure to escape without admitting air, and as soon as the pressures are again substantially balanced the valve closes. Now in both these constructions there are defects. In the first, that wherein the electrode-opening is used, the reciprocating movements in the passage cause



ENCLOSED ARC LAMP.

an irregularity in the flow of gas, there being friction between the solid electrode and the fluid gas. An inward movement of the electrode retards the outward movement of the gas and at the same time tends to carry air with it. An outward movement of the electrode promotes the escape of gas and retards entrance of air. These movements of the carbon also vary the displacement of gases within the globe, which likewise affects the pressure. The result of these actions, therefore, is that the pressure inside the globe fluctuates and more air is admitted to the globe than would be the case if the passage was not restricted by a movable body within it. In the second instance, where the mechanical valve is used in the opening not otherwise restricted or obstructed, it is evident at once that the internal pressure of the globe will fluctuate very materially, because the weight and inertia of the valve permit the pressure to build up before it will allow it to escape, and when it finally opens the release of pressure will be correspondingly excessive. It being understood that variations of the gas-pressure affect the light and life of the carbons, it is evident that the mechanical valve arrangement is not desirable. Now it will be seen that the defects in the operation of the two constructions described are due to the fact that the passage for the escape of the gas is, in one way or the other, restricted or obstructed and that the outer and inner pressures can not freely and naturally adjust themselves automatically, as the burning of the arc demands. The inventors claim that their invention overcomes this defect; which consists in general in providing an unrestricted escape-passage for the gases developed inside of the globe, which passage is at the same time so constructed as to provide an effectual barrier to the entrance of the atmosphere. To this end they employ the usual globe and provide a cap-plate that fits upon the same and has a central opening through which the upper carbon passes. The cap-plate furthermore is provided with a pair of passageways to which are connected depending open-ended tubes that extend nearly to the bottom of the globe. These tubes and passageways furnish unrestricted channels for the flow of gas or air, and it will be seen that since in the normal operation of the lamp the pressure of the gases inside the globe is greater than that of the atmosphere, there will always be a flow outward through the tubes. As a result, the internal pressure will remain practically constant. It will also be noted that since the tendency of the heated gases is to rise, this fact, together with the pressure of the gas, will ensure the constant presence of gas in upper ends of the passageway, and this will act as a bar to the inward flow of air.

The value of waterfalls has greatly increased since the electrical era. Time was when a cataract was valuable only for scenic purposes, but now it is useful as well as ornamental. Niagara is worth $1,000,000,000 more as a source of electrical power than merely as a sight. California waterfalls are increasing in value in a commensurate degree. Snoqualmie Falls, in Washington, has enhanced in value 5,000 per cent in the last few years. A proposition is now under way to generate electricity therefrom for use over a portion of the Great Northern Railway.—*Mining and Scientific Press.*

News from Great Britain.

(By Our Special Correspondent.)

THE ELECTRIFICATION of the Mersey steam railway, which, as has already been mentioned in these notes, is being undertaken by the British Westinghouse Company, is rapidly approaching completion. The line is about four and one-half miles in length, and forms a means of intercommunication between Liverpool and Birkenhead, on either side of the River Mersey, running in a brick tunnel underneath the river. The system forms an admirable opportunity for the substitution of electric traction as the only competition that can come from anything is in the shape of river craft above. A completely insulated continuous-current system has been designed, and the trains, which will consist of five coaches—three intermediate trailers and motor cars at either end—will be equipped with the Westinghouse electropneumatic system of control. The power-house equipment will include three Westinghouse 1,200-kilowatt dynamos of the usual railway overcompounded Westinghouse type, at a pressure of 650 volts and running at ninety revolutions per minute. The lighting of the stations, etc., is to be run off separate circuits for which two compound-wound generators of 200 kilowatts capacity will furnish the necessary power. The traffic between these two centres of population is even now enormous, when it is generally acknowledged that no one will take the journey in the sulphur-laden tunnels unless necessity compels. The argument now being freely put forward by the advocates of electric traction that increased facilities create new traffic, when applied to the Mersey Railway, should leave no doubt in the minds of the company as to the success of the new conditions of things which is expected to be in full swing by the end of this year. Remembering that the orders in connection with this conversion were not placed until last July, the Westinghouse company is to be congratulated in the matter.

A rather large number of manufacturers' protective associations have been brought into existence during the past year or two, and hints have not infrequently been thrown out that rather more than the proper number required of such bodies have been formed. But at certain times all these bodies give evidence of justification for their formation, and just at present the electrical fraternity has reason to be thankful to the National Electrical Association for a piece of vigilance in its interests. The London County Council having asked for bids in connection with electric lamps specified to be of British make, accepted the tender of the Brush company. But the association above mentioned called the attention of the council to the fact that that particular lamp company's lamp works are in Vienna and therefore the goods could scarcely be termed "British made," and the reply of the London County Council to the effect of being "aware that the lamps supplied by the Brush Electrical Engineering Company would be foreign made" has hardly poured oil upon troubled waters. If the council asks for British-made goods, which it did in this instance, it is likely to precipitate severe criticism.

I made a reference recently to the inclusion of generating stations in the list of places placed under government supervision by the new Factory Act, and the radical difference between the internal construction of such buildings and the methods of administration, and such factories as textile and other manufactories, has influenced the Institution of Electrical Engineers to take up the matter, and a conference has been held by which the Home Secretary will be asked to amend the act as regards these particular places. The hand of the Institution is being strengthened by the London Chamber of Commerce. The general feeling is that certain clauses in the act are prejudicial to and likely to hamper the progress of the industry, a thing not unknown in the past. One great grievance concerns the employés in attendance at substations. The act stipulates a skilled mechanic for this work, but, as is well known, this is absolutely unnecessary, to the needs of a substation, and it further deprives younger men of valuable experience.

The four-cornered contest which has been raging in the House of Lords committee rooms for over a month in respect of underground tube railways in London has so far ended in a victory for Morgan, inasmuch as all the other competitors who were endeavoring to secure what is considered to be the main route through London, *viz.*, Hammersmith-Piccadilly-City, have had their bills struck out, and Morgan's proposal, which will run from Hammersmith along the same route to the city and thence away to the north and north-east, is to be further considered. The chances of his ultimate success may be better gathered when it is stated that Parliament itself has asked for such a line as he is proposing, and that his alone remains. Morgan finds the money, but the engineering is purely British, and the proceedings before committee have elicited some important modifications to the Central London and City and South London railways. Thus, instead of a third rail running between the track rails, and the latter being utilized as the return, two conductors are to be placed on the side of the tunnel. The size of the tunnel is to be increased to a sufficient size to allow of an emergency platform on either side of the train, and an additional footway is to be provided between the running rails. Then the tunnels are to be lighted—by the way, this is now done on the Central London—and the multiple unit system used from the outset. The system of fares which will be binding upon the company when it is formed will be even cheaper than the second all-round schedule adopted on the "Twopenny Tube," although the two lines will not compete to any great extent. The greatest competition will be with the electrified lines of the District and Metropolitan companies in the hands of Mr. Yerkes, and as it is somewhat unlikely that the latter's fares—owing to past financial complications—will for some time be anything so low as on the Morgan line, the shareholders are not by any means out of the woods yet. What Londoners have been content with in the matter of locomotion in years gone by sets one marveling, indeed, when comparisons are made, having in mind the care which has been taken in the past to build railways away from the lines of the traffic.

The Liverpool overhead railway accident has had the effect of inducing the Central London company to expend a considerable sum upon the complete protection of the multiple motor trains against fire. The connecting cables between the motors and controlling arrangements have been altered from india rubber flexible cable to cables with asbestos

and non-hygroscopic tape insulation, with an outer covering of phosphor bronze plaiting. An iron sheathing lined with asbestos has been attached to the underfloor of the cars over the motors, and in fact the whole of the trains in the vicinity of the motors have been treated in this way.

The telephone bill, which was being promoted by the Manchester corporation and a large number of adjoining local authorities, and about which so much was heard at the beginning of the session, has been withdrawn. After all of the expense and trouble which it has entailed, only now has it been discovered that licenses granted by the Postmaster-General to each of the several municipalities will bring about the same result as a bill. There would appear to have been a lack of foresight somewhere.

After all the stress and strain which was so evident at the time of the debate on the Government telephone subscriptions, and on the general question of competition with the National company in London, an air of tranquility and satisfaction pervaded the annual dinner of the latter body a few days ago. There are now 226,000 subscribers which works out at a telephone for one out of every 183 of the population. The company's exchanges number 1,025, and the chairman's remarks in reference to the Glasgow and London municipal competition were made with a lighter heart than was the case twelve months ago. The number of message-rate subscribers at £4 15s. per annum are 30,000, and at £3 something over 5,000, and great efforts are now being made to develop this cheaper form of service. One noteworthy remark was the expression of opinion that the work of telephony in this country has only just begun.

Another good work accomplished by the Institution of Electrical Engineers last session was the appointment of a committee to enquire into the legislative conditions under which the electrical industry in Great Britain has to exist. It has been felt for some years past that electrical engineering generally was not receiving fair treatment, and it was only after many appeals that the above committee was formed. The chief points put before it were as to the backward state of the industry here as compared with other countries, as to the changes desirable in procedure in order to reduce the time and expense incurred in obtaining authority to carry out electrical undertakings, and as to the most suitable arrangements for placing the knowledge of the Institution at the disposal of the Board of Trade so that that body might carry out its duties in the best informed way. A vast amount of evidence was taken from gentlemen expert in various branches of the industry, and overtures are to be made to secure the collaboration of Parliament in making the path of electrical application less difficult in the future.

As a matter of fact, in the domain of electrical supply, the acts of 1882, etc., are now being administered with a freer hand than hitherto was the case. One of the most troublesome difficulties in days gone by was the persistence with which petty local authorities would obtain provisional electric lighting orders and at once deliberately shelve them with the satisfaction of having prevented a company, willing to commence its work at once, from coming into the neighborhood. But under the newer conditions of supply from the wholesale companies distributing current over enormous areas, it is becoming not uncommon for any district council or other municipality when applying for powers within the area covered by the same company, to be given such powers on the understanding that if within three years an adequate or any supply is not given, the company has the right to supply. It has been the practice of some parishes to have powers for years without putting them into effect. A. W.

June 2.

Book Reviews.

"The Arithmetic of Electrical Measurement." W. R. P. Hobbs. Ninth edition. London. Thos. Murby. Cloth. 112 pages. 5 by 7 inches. Many illustrations. Supplied by the ELECTRICAL REVIEW at 50 cents.

This is a useful little handbook for teachers of electricity, the examples given in it being absolutely practical and based upon the common experiences which the electrical worker will encounter.

"A. B. C. of Electrical Experiments." W. J. Clarke. New York. Excelsior Publishing House. Cloth. 146 pages. 5 by 7½ inches. 144 illustrations. Supplied by the ELECTRICAL REVIEW at $1.00.

This is a book intended for boys. It tells in a simple way how to make a number of simple pieces of apparatus, and is the kind of book that should prove highly entertaining to the average boy of mechanical tastes.

"Small Dynamos and Motors." F. E. Powell, London. Dawbarn & Ward, Limited. 76 pages. 5 by 7 inches Numerous illustrations and tables. Furnished by the ELECTRICAL REVIEW at 50 cents.

This little book is intended for amateurs who wish to construct small dynamos or motors. It gives some good practical ideas on their construction, with a large number of working drawings showing how to construct the machines and wind the armatures and fields.

"The Electrical Engineer's Pocketbook." Horatio A. Foster, New York. D. Van Nostrand & Company. 1,000 pages. 4½ by 7 inches. Furnished by the ELECTRICAL REVIEW at $5.00.

This is the second edition of an excellent work. The sale of this book has been unprecedented in electrical literature. The book is replete with useful information of every description, and contains tables, diagrams, in fact everything which the electrical engineer might find useful in his profession. It is well printed, and, above all, carefully indexed, and is well worthy the great favor with which it has been received.

"An Elementary Treatise on Alternating Currents." W. G. Rhodes. Many diagrams. 211 pages. Cloth. Longmans, Green & Company. 5 by 8. Price $2.60.

This book, while an ably written work, hardly fulfills the object of the author as stated in the preface, *viz.*, to produce a treatise on alternating currents which shall be as free from mathematical complications as is consistent with a clear understanding of the subject. In his effort to accomplish this much desired end the book is made more difficult to read by the omission of certain intermediate mathematical transformations. Also in one or two instances the formulæ used are not derived from the fundamental equations.

The work covers the general theory of alternating current, single and multiphase; a short treatise on vector algebra; the design and testing of transformers; the usual types of alternating-current dynamo electric machinery, such as generators, induction and synchronous motors and rotary converters, and chapters on power transmission and methods of measurement. An appendix gives the solution and deviation of some of the formulæ used in the body of the work. The insertion of a number of practical problems at the end of each chapter is a valuable feature. The defect common to all works yet published on the subject of alternating currents is also present in this book—*viz.*, the failure to treat each problem exclusively from its physical side and developing therefrom the fundamental equations on which the whole mathematic fabric rests. Some day such a work will appear and its fortunate author will reap a harvest, both of fame and shekels.

The author's nomenclature is accurate, and he is one of the few writers of technical works in the English language who is able to tell the difference between a spiral and a helix.

The book, mechanically, is of the best order, and the division of the matter into paragraphs and printing of the dominant words, definitions and phrases in bold, heavy type, make it a handy reference work.

Reviews of Current Engineering and Scientific Literature.

Giving Concisely the Substance of Important Papers in the Scientific, Electrical and Engineering Press of the World.

The Manufacture of Coke from Compressed Fuel.

The idea of compressing fuel for coking purposes originated on the Continent, where many of the coals coked so indifferently that it was of the greatest importance to adopt any method which gave a prospect of improvement of the resulting coke. It had been observed that the coke produced from the lower portions of retort ovens, compressed by the weight of the superincumbent fuel, was superior to that produced from the upper portions of the charge, and this led to experiments in compressing fuel by various means: First, by stamping in the oven, by hand, in other cases by weighting the charge; and from this practice compressing in a box outside of the ovens was gradually evolved, the stamped coke being afterward moved out of the box into the oven by mechanical means. The results obtained from numerous tests show that the quality of the coke is distinctly improved by compression. The essential parts of the appliances used are stamping machines and compression boxes. In operation, the sides of the stamping box are closed and adjusted to suit the width of the oven to be charged, and the front and back plates are fixed in position. The fuel is then run into the box and stamped in layers, and when the fuel to be coked is ready the machine is moved up to the oven door to be charged. The fuel is served into the box and stamped in successive layers about ten inches deep. On top of the compression box a stamping machine mounted on four wheels travels on a track the entire length of the box. The stamping machine is a steel frame structure carrying an electric motor, worm and wheel reducing gear, lifting and releasing rollers for the stamping, also a traveling gear for moving the machine along the length of the compression box, and back. The stamping heading is mounted upon a long wooden shaft, and on every up-stroke the traveling motion comes into action.—*Engineering* (London), May 23.

Some Preliminary Experiments on the Motion of Ions in a Varying Magnetic Field.

The negative results of Crémieu's search for a force acting on a static charge in a varying magnetic field have led Bergen Davis, of Göttingen, to perform some experiments which are detailed in an interesting article under the above heading. The scheme of the Crémieu experiments may be briefly described by the statement that a disc which was charged to a high potential was suspended in the field of a strongly excited electromagnet. It occurred to the author to use the negatively charged ions in an ionized gas as the carriers of the static charge. An ion, because of its high charge, should move with considerable velocity in a varying field of moderate strength. For the purpose of showing the theoretical magnitude of such ionic motion in such a field an ideal case was assumed. Suppose that a cylindrical vessel is placed in a coil of a few turns through which is passing an oscillatory current of high frequency. Assume that there is a complete vacuum, except for one negative ion, which at the initial time is at raised contact distance, r, from the centre of the coil. The ion will be acted upon by a force, and the direction of such will be a circle of radius, r, about the magnetic centre of the coil. Neglecting the centrifugal acceleration and the change in apparent mass due to its motion, if the maximum strength of the field at the position of the ions is 100 C. G. S., and the frequency is 10^6, it may be shown that the ion would exact harmonic oscillatory motion in a circular path around the centre, with a maximum displacement from the position of rest of twenty centimetres and a maximum velocity of 13×10^7 centimetres per second. Since, for the purpose of experiment, it is desirable to have ions in abundance and a rapidly varying magnetic field, the well-known electrodeless discharge in a Tesla oscillatory field was made use of. To demonstrate by experiment that in all probability the ions move by a short distance, and are then stopped by collisions with the molecules, producing by the collision many other ions, which by impact produce yet others, accumulating under this effect a strong current until the ring discharge is produced, the author made use of a miniature anemometer. The arrangement of the apparatus consisted of four large twenty-litre Leyden jars joined in parallel, the inner coatings of each jar being connected with a spark-gap, and the outer coatings with a coil. Within this coil, which consisted of eighteen turns of coarse wire, was placed a small cylindrical glass vessel, this being in permanent connection with a mercury air-pump. A miniature anemometer, consisting entirely of glass, was mounted on a needle point so as to turn with great freedom. Between the coil and the vessel was placed a Faraday cage which was made by attaching narrow strips of tin-foil on a glass cylinder, so that the strips were perpendicular to the plane of the coil. This was found to shield the vessel very well from external electrostatic effects. The jars were charged by an induction coil excited by an alternating current of forty complete periods per second. The length of the spark-gap was 11 mm. When the proper degree of excitation was obtained upon the passage of the gaps, a white ring discharge was produced and the anemometer rotated in the direction of the convex side of the cups.—*Science* (New York), May 30.

The Capillary Electrometer.

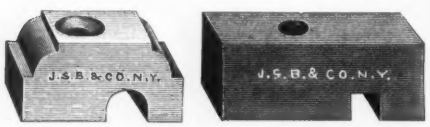
What may be called the insulation and resistance of the capillary electrometer is important for two reasons—first, as to its bearings on the theory of the instrument, and second, as affecting the method of using it in dealing with electrical charges or quantities of limited amount. In making some practical experiments on the properties of the capillary electrometer, a quick-acting electrometer was made, its parts carefully insulated with freshly cut soft rubber, and joined up in series with a very sensitive galvanometer in the derived circuit of a potentiometer, both instruments being furnished with short-circuiting keys. On opening the electrometer key there was a large excursion of the meniscus. As soon as it had come to rest in its new position under the action of the electro-motive force, the galvanometer short-circuit key was opened. There was no deflection, but anything that caused the meniscus to move, whether a slight change in pressure of the mercury, or a small movement of the rider of the potentiometer, produced a large but always temporary deflection of the galvanometer. —*The Electrician* (London), May 30.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Telephone and Cross-Arm Cleats.

James S. Barron & Company, West Broadway and Franklin street, New York city, has recently been paying particular attention to the manufacture of its telephone cleats and cross-arm cleats. The company is now manufacturing maple telephone cleats for interior use which are highly finished and carefully made. One is a cross-arm cleat for outside telephone use and is manufactured in standard sizes for triple wire on cross-arms. This cleat is very strongly made and is particularly intended to withstand the ravages of all kinds of weather.

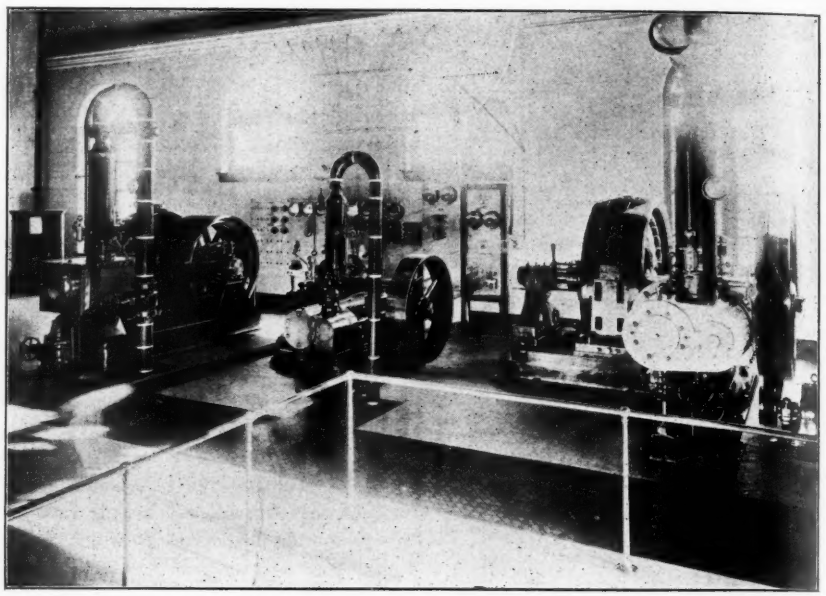


TELEPHONE CLEATS.

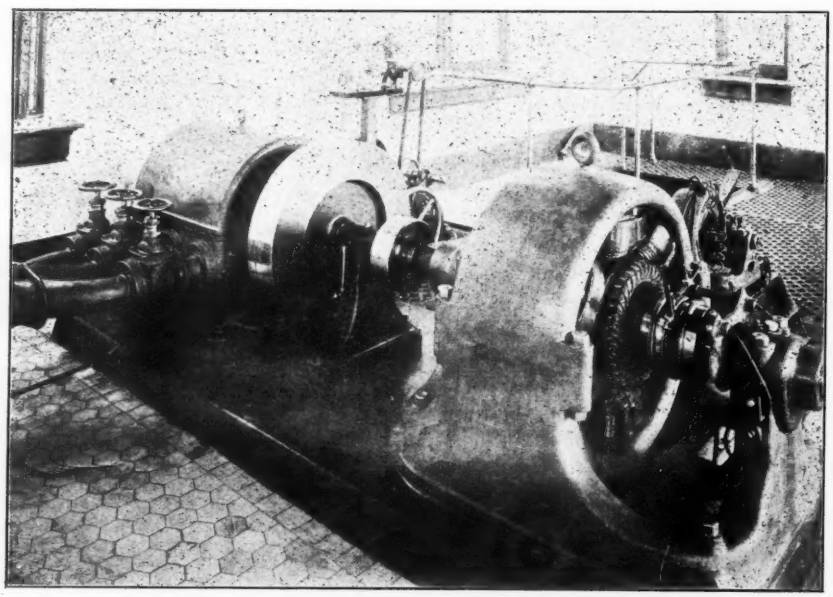
Another is a telephone cleat which is made in two sizes for double or triple-twisted house wire. It is finished in plain wood and can be stained to match the color of whatever woodwork with which it may be placed. The company also makes a cleat for double-twisted wire. This cleat is made in black walnut and highly finished. In the manufacture of these cleats great care is taken by the company to see that they are smoothly finished and made to match one with the other so as to prevent any incongruity in the using of a number of cleats close together.

The St. Louis Municipal Electric Power Plant.

One of the interesting installations which should afford great pleasure in visiting to the engineer attending the Louisiana Purchase Exposition is the city waterworks and electric light and power plants. This plant furnishes current for the municipal railway, extending from the Baden pumping station to the Chain of Rocks, and for lighting the several buildings belonging to the water department and located at various points in a distance of about five miles along the Missouri River. The electric plant is, in a way, an adjunct to the pumping station, and is a model station for its size, being splendidly equipped and maintained.



THE ST. LOUIS MUNICIPAL ELECTRIC POWER PLANT.

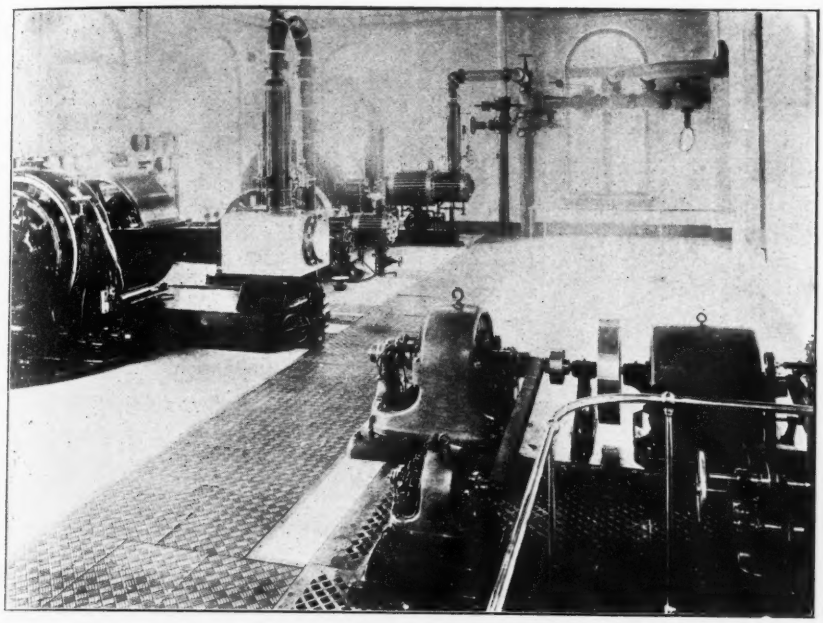


TWENTY-KILOWATT ALTERNATOR DIRECT-COUPLED TO WATER-WHEEL, ST. LOUIS MUNICIPAL ELECTRIC POWER PLANT.

The electrical equipment consists of a 100-kilowatt railway generator and two alternators, one of 100 kilowatts and one of twenty kilowatts, with exciters, switchboard, transformers, etc., all furnished by the Westinghouse Electric and Manufacturing Company, of Pittsburg, Pa. The direct-current machine operates at 575 volts and 275 revolutions per minute, and is direct-connected to a straight-line engine. This generator has run continuously at full load for twenty-four hours with a temperature rise above the surrounding atmosphere of considerably less than forty degrees centigrade. In the same test the economy of the engine was twenty-two pounds of steam per horse-power-hour.

The large alternator, which is used during the heavy lighting load in the evening, is of the revolving field, single-phase, engine type, running at 277 revolutions per minute, 1,150 volts and 7,200 alternations. In a twenty-four-hour full-load test it has shown a maximum temperature rise much below forty degrees centigrade. It is direct-connected to a tandem-compound Ideal engine. The exciter for this ma-

chine is of 3.75 kilowatts capacity, and is a multipolar, compound-wound, belted generator running at 125 volts and 1,600 revolutions per minute.



ST. LOUIS MUNICIPAL ELECTRIC POWER PLANT.

The twenty-kilowatt alternator, which is also used for lighting, operates during the entire day and that part of the night in which the load is light. It is direct-connected to a Pelton impulse water-wheel supplied from the water mains and running at 1,200 revolutions per minute. This method of transmitting power through the engine and pump to the dynamo may at first seem questionable, because of the many transformations and consequent loss of energy involved, but when it is remembered that the efficiency of a large pumping engine is high, while that of so small a steam engine as twenty kilowatts would be low, the reason for the choice of this method is apparent. Indeed, tests have shown that the Pelton water-wheel is so efficient that this generator is operated on a total steam consumption of about thirty pounds per electrical horse-power-hour, which is probably much less than could be obtained with so small a unit by direct connection to an engine.

Of course, the principal advantage of the water-wheel drive is in the matter of first cost, a water-wheel costing much less to install and requiring less care than an independent steam engine of the same capacity. The exciter is a 0.56-kilowatt compound-wound multipolar machine, running at 1,400 revolutions per minute and 125 volts.

Brass Fittings for Telephone Service.

Among the many improvements which from time to time the manufacturer has put forth for practical telephone purposes, that which makes for rapid and safe manipulation in joining cable work is eagerly sought by the construction department. Manufacturers of lead-covered cables carrying wires for the distribution of electricity concede the difficulty which exists in making satisfactory joints. The New Haven Novelty Machine Company, New Haven, Ct., has placed upon the market a patented novelty slidable sleeve, pothead, Y-branch and terminal head, which the company claims is something new for all users of lead-covered wire cables. These devices are air and moisture-proof, and skilled labor is not required in making connections.

In Fig. 1 is shown the slidable sleeve. In operation the tapered end of the sleeve is unscrewed and this is passed over the cable, the rest of the sleeve being slipped over the opposite end of the cable. The wires are spliced in the usual manner and the tapered end is screwed into the sleeve, using red lead on the tapered screw thread. The sleeves are placed centrally on the cable so that the splicing will be in the centre, and the gravity joints are then soldered to the lead pipes containing the insulated copper wires, making them air and water-tight. This is adjustable over considerable dimensions, and measurements are necessary. The advantages of the slidable sleeve are still more apparent when the Y-branch is used, not only on account of the saving in time and labor, but because of the increased cost of wiping a lead Y-branch. The slidable joint gives a flexibility which the lead Y-joint does not, and the inspection can be had at any time and as often as desired.

In Fig. 2 is shown the novelty pothead, which has the advantage of the slidable sleeve with the further feature of being made of brass; it can be heated and the composition contained therein allowed to run off. This pothead consists of but two pieces—a brass piece and a soldered end. This end is furnished filled with solder, so that all that is necessary is to unscrew the soldered end from the sleeve and pass the sleeve on the cable; then with an iron solder the head to the cable. After splicing, the sleeve is screwed up to a finish, when it is ready for the application of the compound. The pothead further commends itself to users, for the reason that it is not necessary to bend the pipe in order to wipe the joint, nor to carry the molten metal up the poles. All that is required is a hot iron to cause the solder in the nut to flow.

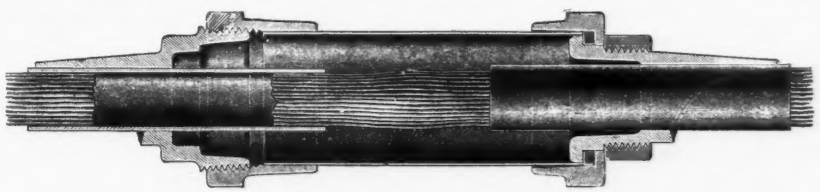


FIG. 1. SLIDABLE SLEEVE FOR CABLE JOINT.

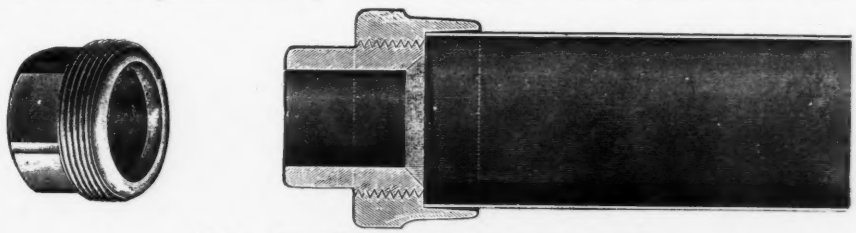


FIG. 2.—BRASS POTHEAD FOR TELEPHONE SERVICE.

Oil Lighting Transformers.

The oil transformers manufactured by the Stanley Electric Manufacturing Company, Pittsfield, Mass., are the result of long and careful research into the relation between cost, insulation, efficiency, regulation, heating, copper loss and aging. The accompanying illustrations show the Stanley oil transformer in different conditions of assembly, Fig. 1 being a rear view and Fig. 2 the coils and core of the transformer. Fig. 3 illustrates a method of separately winding and insulating the coils of a ten-kilowatt and four-kilowatt transformer, and Fig. 4 shows the connections of the primary terminal board.

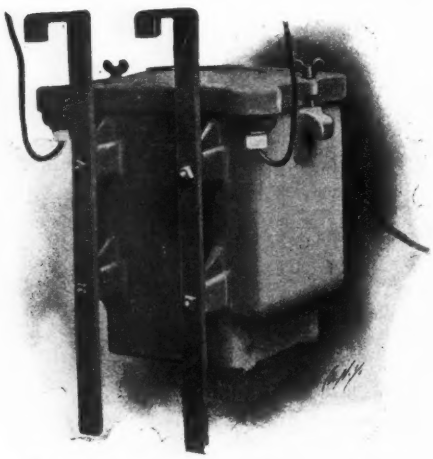


FIG. 1.—TRANSFORMER AND HANGER IRONS.

The life of a transformer depends upon its insulation. With this type of transformer the winding is subdivided into either six or ten coils, depending upon the size. Each coil is wound and insulated separately. In assembling, the coils of each half are slipped into one another, as is shown in Fig. 3. By this method a high degree of insulation is provided between the core and case, affording exceptional security against rupture by lightning discharges. These transformers are required to withstand a test of a difference of potential of 10,000 volts, both dry and oil filled, between primary and secondary coils and core, and coils and case. The core loss and regulation of a transformer are interdependent on the temperature rise, being constant with both. The maker claims that these transformers will be found to embody noteworthy improvements with regard to core loss and its relation to regulation, an unprecedentedly low temperature being procured. The hanger irons are secured to the transformer by means of bolts which slide into lugs on the back of the case, and are drawn tight after the transformer is in position, holding it securely in place. The transformer is made so that, if necessary, it sets squarely upon a plane support. A thick strip of felt is inserted in a groove in the cover, which effectually prevents the entrance of moisture or the escape of oil, the use of rubber not being allowed owing to the deteriorating effects of oil upon its composition. This cover is bolted into place, and has extending all around it a broad lip as a further precaution against the entrance of moisture.

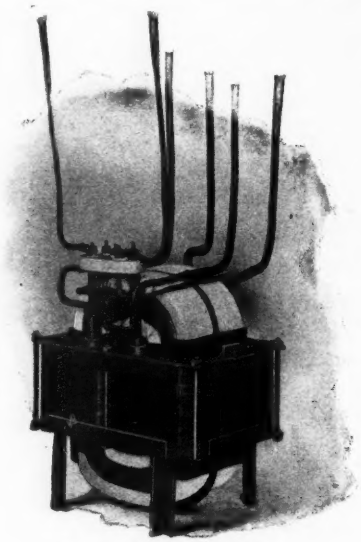


FIG. 2.—COILS AND CORE.

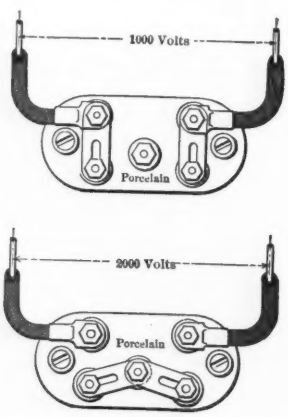


FIG. 4.—PRIMARY TERMINALS.

A terminal board of porcelain is provided for the primaries, affording great facility for changing the coils from series to parallel connection and *vice versa,* as is shown in Fig. 4. The primary and secondary leads are brought through heavy porcelain insulators to the outside of the case. The openings through which the leads pass are sealed by flowing a special cement around them, which permanently fills up the openings, making them air-tight.

These transformers can be connected for three-wire distribution without any modification. No complicated internal connections of the secondary coils are required to ensure good regulation with unbalanced loads, as due to the arrangement of the super-imposed primary and secondary windings, with full load on one side of the neutral and no load on the other side, the maker claims that the difference in electro-motive force between the two sides will not be greater than the regulation of the transformer from no load to full load. These transformers are built in sizes ranging from one-half kilowatt to thirty kilowatts capacity for voltages as high as 1,200 or 2,400 on the primary and 120 or 240 on the secondary.

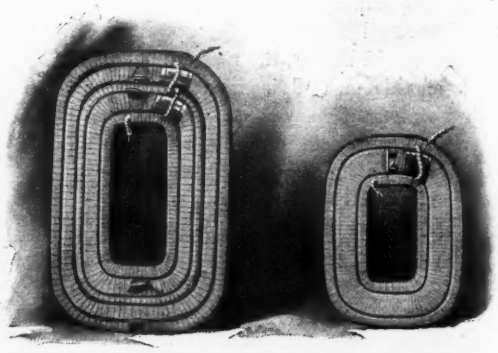


FIG. 3.—WINDING OF TEN AND FOUR-KILOWATT TRANSFORMERS.

Theatre Fans.

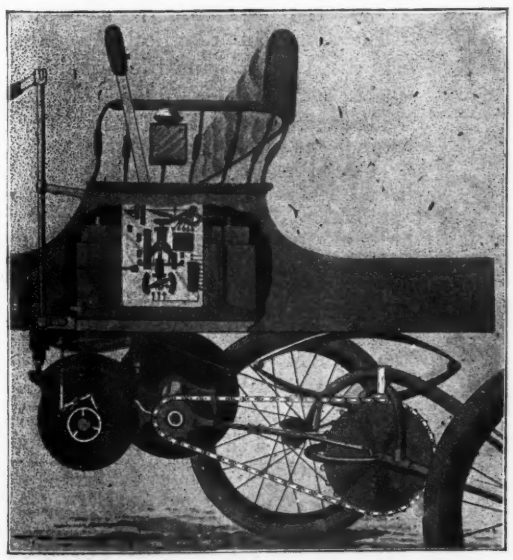
A few years ago, before the advent of electric fan motors, theatres were places to be shunned during the hot weather, but with the wonderful improvement in the manufacture of this character of apparatus, theatrical managers in many instances reap their greatest harvests during the summer months, because of the fact that they are enabled, by a careful adjustment of fan motors, to make the theatres the oasis in the cities. This idea is emphasized by the recent notices of the various theatres which are operated throughout the country by Proctor and the Proctor Stock Company, and in which "coolness and pure air" is advanced as the attractive feature.

The production of bismuth ore in the United States in 1901 amounted to 319 short tons, as compared with 220 short tons in 1900. Colorado supplied the entire output, Lake County contributing 254 tons and Ouray County 65 tons. The importation of bismuth into the United States in 1901 was 165,182 pounds, valued at $239,061, against 180,433 pounds, valued at $246,597, in 1900.

Electric Motor Vehicle.

The Ajax Motor Vehicle Company, of New York city, has recently placed upon the market a splendid type of electric vehicle which embodies a number of improvements and a condition of efficiency which makes it very popular for road work. With the coming of the summer season there is undoubtedly a great boom taking place in the sales of horseless carriages. It is evident that if the electrically driven vehicle comes anywhere near maintaining a high degree of efficiency, it is the most popular type of carriage for this form of recreation.

IMPROVED ELECTRIC CARRIAGE.



ELECTRIC CARRIAGE, SHOWING PARTS IN DETAIL.

With this electric carriage the maker claims that it will give almost twice the mileage of those electrical vehicles which have hitherto been made. It is capable of three speeds both ways, with a new and simple controller, with an automatic reverse in the handle and two safety brakes. The running gear is built up of the best of drop forgings throughout. Steel tubing, perfect brazing and carefully designed joints ensure flexibility, and make easy going over the most uneven roads. The springs are of the best oil-tempered steel tested to resist a weight of 3,500 pounds. An enclosed spur differential gear enables the turning of curves without straining on the gear or body and obviates entirely the possibility of overturning. The wheels have electrically welded rims with steel spokes and hubs which are turned from solid bar tool steel. Ball bearings are used throughout, the cups and cones being finely ground of the best material.

Pneumatic road tires are used and the finish is of the piano-box type. The frame is of angle-iron construction, which gives ample room under the seat for a battery of very high capacity.

A one and one-half horsepower motor, which is suspended from the bottom of the body by a patented device giving great freedom of action and durability, is installed and the battery consists of twelve cells of high ampere-hour capacity, which gives a very large radius of action. The voltmeter is of the standard Weston make.

Side electric lamps and an electric searchlight, when desired, are also furnished with this carriage.

The Summer Meeting of the American Institute.

The meeting of the American Institute of Electrical Engineers to be held at Great Barrington, Mass., on June 18, 19, 20 and 21, in addition to a very interesting technical programme, will receive a welcome from the people of Great Barrington and vicinity of the most cordial and generous nature. Great Barrington is an ideal place for the meeting, and the members, quite generally appreciating this fact, will be accompanied by their families.

The special train over the New York, New Haven & Hartford Railroad leaves the Grand Central Station, Forty-second street, New York city, at 2 o'clock P. M., Tuesday, June 17, arriving at Great Barrington about 5.30 o'clock that afternoon.

Every member of the Institute should endeavor to attend, and those who take their families will undoubtedly ever have cause to remember most pleasantly this meeting among the Berkshire Hills.

Dr. F. A. C. Perrine, of the Stanley Electric Manufacturing Company, Pittsfield, Mass., and Mr. William Stanley, of the Stanley Instrument Company, Great Barrington, Mass., and their associates, with the local committees, have spared no efforts in making arrangements for the complete success of the gathering.

Illumination of the Hartford, Ct., Capitol Dome.

In the presence of a large number of spectators one evening last week a test was made of the device proposed for the illumination of the capitol dome at Hartford, Ct., by electricity. A series of fifty-seven ten-candle-power incandescent lamps were placed in the south panel of the dome, the lights arranged so that there was a vertical row of twenty-four lights running up the sides of the ribs to the lantern cornice. Across the bottom of the panel was a row of six lights, and at the top, joining the vertical rows together, were two lights. The experiment was successful in every way and was satisfactory to Comptroller Chamberlain and the New England Engineering Company. The portion of the dome thus illuminated is only one-twelfth of the entire surface. When all twelve panels are illuminated there will be at least 834 lamps required. This is expected to produce one of the most beautiful permanent electrical displays in the country. It is announced that the lamps will be in place so that the dome may be fully illuminated on the fourth of July, and work will be begun at once upon the permanent installation. The New England Engineering Company, of Waterbury, Mass., has had charge of putting the experimental device in position.

New York Electrical Society.

The 225th meeting of the New York Electrical Society was held June 4. Dr. William Hallock lectured on "The Magnetic Deflection of Steel Plumb Lines in Deep Mines." In the course of his lecture Dr. Hallock said that in the search for copper in the ever-increasing quantities needed for the electrical industries, the Tamarack Mining Company has sunk the deepest shaft in the world in order to tap the vein which slopes downward from the surface. This hole is well over a mile in depth. In order to connect a point on this shaft with the older workings of the mine it became necessary to "plumb down" two points so as to be able to start in the right direction to meet the other tunnels. This operation was undertaken at the twenty-ninth level, with lines 4,250 feet long, with steel piano wire, No. 24, carrying a fifty-pound iron weight. The two plumb lines were about seventeen feet apart, and it was found on accurate measurement that in one case they were 0.11 foot and in another 0.07 foot farther apart at the bottom than at the top. It was supposed that possibly they might be closer together on account of the convergence of the earth's radii, or the attraction of gravitation between the two weights. Various suggestions were offered for the divergence, air currents, attraction of the walls, etc. Owing to the fact that the weights were in an enclosed space they would not be under any force of attraction due to the surrounding walls, and if the walls did attract, it would be quantitatively too small, only about one hundredth of that observed.

The well-known observations upon the very strong magnetization of the steel casing used in gas and oil wells suggested that the wires were magnetized by the vertical component of the earth's field, and having two north poles at the bottom would repel each other. A series of experiments made in the 100-foot shaft of the physical laboratory at Columbia University, with plumb lines seventy-five feet long, showed conclusively that they are repelled from each other and that the bottom is drawn toward the north. The measured displacement was about 0.3 millimetre or 0.012 inch, which was very easily measured with a microscope. It was found that owing to the lack of homogeneity of the wires irregularities of magnetization were developed, which tended to increase the repulsion.

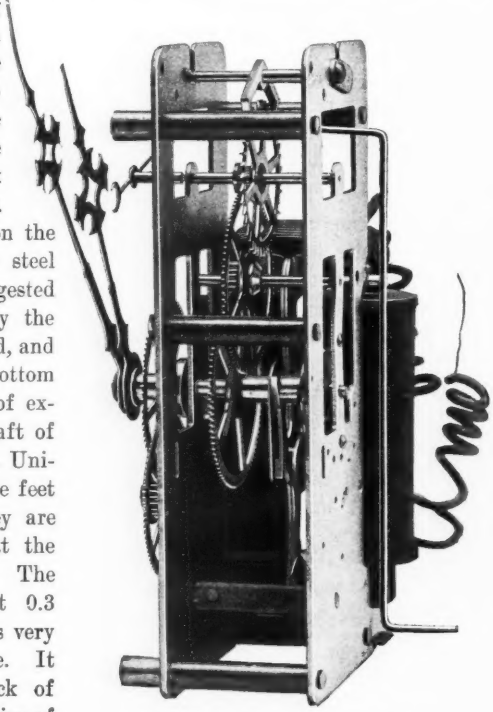
Professor F. W. McNair and Chief Engineer Watson, of the mine, have since made a considerable series of experiments with bronze wires and lead weights, which gave results very similar to those originally obtained. This goes to show that a study of the air circulation was necessary, and they concluded that the disturbances were due to air currents. Of course it may be that the deflections were mainly due to air currents, but the observations at Columbia would show that magnetic deflections are to be expected, and indeed may have been present with the other in some cases. In Dr. Hallock's opinion the moral of the whole experience should be: use bronze wires and lead weights and do not use such long lines unless air circulation can be completely stopped.

After the conclusion of Dr. Hallock's lecture the society adjourned to the office of the American Telegraphone Company. The members were received by Mr. E. W. Creecy, the vice-president of the company, who gave an address on the commercial side of the telegraphone. The subject was covered technically by Mr. William J. Hammer. The capabilities of the instrument were practically demonstrated.

Before adjournment, thirty-one new members were elected.

An Electrically Wound Clock.

The self-winding clock, manufactured by the National Self-Winding Clock Company, of Bristol, Ct., is wound automatically by electric current from cells of dry battery contained within the case. The batteries will run the clock from twelve to eighteen months, when a new set of batteries can replace those run down in a very short space of time.



An Electrically Wound Clock.

This clock, a form of which is shown in the accompanying illustration, is wound electrically once in seven or eight minutes, thus securing uniform tension upon the running train. This is so regulated through the slot in the dial that no other attention is necessary, the maker claims, than occasionally setting and replacing the batteries. The electrical device operates by a sliding contact which can only act when the spring is uncoiled to an extent requiring rewinding, and can in no possibility remain in action beyond the fixed and necessary point. The length of time during which the circuit is closed is less than one-fortieth of a second in each seven to eight minutes, which will explain the long life of the battery in connection.

Cotton Tape.

The Massachusetts Chemical Company, Boston, Mass., is placing upon the market a cotton tape, reeled on patent aluminum bobbins, in two sizes. This cotton is dried to drive out the water, and the pores are then filled with a plastic self-healing compound which permanently excludes moisture. This tape is made of the closest woven, strongest fabrics obtainable, and is cut in any desired width. The process is protected against any possible infringement and the cost has been reduced below that of the old-fashioned tape.

Canadian Electrical Association.

The Canadian Electrical Association held its twelfth annual convention at Quebec on June 11, 13 and 14. The headquarters were at the Chateau Frontenac, and interesting papers were presented by several authorities on different subjects.

Sale of the Stanley Electric Manufacturing Company.

The announcement is made of the purchase of the control of the Stanley Electric Manufacturing Company, of Pittsfield, Mass., by William C. Whitney and Thomas F. Ryan, of New York, and Thomas Dolan, William L. Elkins and P. A. B. Widener, of Philadelphia. This company's extensive and modern plant was described in the Electrical Review, November 2, 1901.

Dr. F. A. C. Perrine is the president of the Stanley company, and Mr. F. W. Roebling, of Trenton, has been the owner of a majority of the stock. The capital of the company will be greatly increased.

The new owners are well-known capitalists and control a majority of the stock in the Metropolitan Street Railway Company, of New York city, the Union Traction Company, of Philadelphia, and the Electric Storage Battery Company.

CURRENT ELECTRICAL NEWS

COMMERCIAL NEWS

DOMESTIC AND EXPORT

BALTIMORE GAS AND ELECTRIC COMBINATION—A movement is on foot to combine the Consolidated Gas Company and the United Electric Light and Power Company in Baltimore, with a view to absolutely controlling the electric light, heat and power interests. It is stated that the same syndicate is seeking control of tne Susquehanna Light and Power Company, which is constructing a large plant for utilizing the Susquehanna River power to generate electricity.

COMPANY FORMED TO BUILD CUBAN RAILROADS—The Insular Railway Company, which proposes to build and operate railroad lines in Cuba, has filed articles of incorporation under the laws of New Jersey. The capitalization of the new company is $2,500,000. One of the new lines will run from Havana to the city of Mariel in the province of Pinar del Rio. The others, which are all to be in the province of Havana, will be from Havana to the city of Guines, from Ponta Brava to Guira de Malena, from El Caney to Manaqua, and several others of shorter distances.

THE EVERETT-MOORE SYNDICATE—It is said that the affairs of the Everett-Moore Syndicate are rapidly being straightened out, and it will soon have charge of its own affairs. The syndicate expects to very shortly sell half of its holdings in the Toledo Railways and Light Company, 6,000 shares of the preferred stock of the Northern Ohio Traction Company, and some minor telephone properties. It has also been announced that its interests in the London street railways will be disposed of to a Canadian syndicate. If these deals go through, the syndicate will have left about 8,000 or 10,000 shares in Detroit United Railway, about 40,000 shares of the Toledo Railways and Light Company, and a controlling interest in the Northern Ohio Traction Company. The large equities obtained from the sales of traction stocks will be used chiefly to finance the Lake Shore Electric and the Toledo Shore Line, and probably the Federal Telephone Company.

SAN FRANCISCO POWER CORPORATION—It is announced that a corporation known as the Feather River Power Company has been incorporated in San Francisco. The president of the company is Charles Webb Howard; vice-president, Charles L. Fair; and the directors are: J. D. Harvey, W. J. Dingee and Major F. McLaughlin. The capital stock of the company is said to be $5,000,000. The properties are located at Big Bend, Feather River, twenty miles from Oroville, and the company contemplates within one year furnishing 20,000 horse-power in San Francisco. The new company has purchased from the Big Bend Tunnel and Mining Company, of Buffalo, N. Y., all the properties of the Big Bend tunnel and its United States patent rights on the Feather River—which extend for fourteen miles—and some 4,000 acres of land. Work will be commenced at once to tunnel from the terminus of the Big Bend tunnel through a small mountain to the Feather River. It is expected that water power to the extent of 40,000 horse-power will be secured in this manner.

ALASKAN RAILWAY—The Klondike Mines Railway Company has begun work on a railway from Dawson up the valley of the Klondike River, across Indian River, to the head of Stewart River, a distance of eighty-two miles through the heart of the Klondike mining district. The estimated cost of the enterprise is between $2,500,000 and $3,000,000, and it is expected that two years will be required to build the road. The company is financed by eastern and Canadian capital, and the contract for the construction has been given to M. J. Heney, the railway contractor who built the White Pass & Yukon Railway. The greater part of the supplies will be purchased in Seattle, and it is hoped to have sufficient men on the ground to carry on the work rapidly in a short time. Surveys over the greater part of the route have been made and approved, so that construction work will not be delayed. The object of the road, as stated by the builders, is to provide transportation for the output of the principal mines of the Klondike region, the ore from which will be brought to Dawson and transported up the river to the northern terminus of the White Pass & Yukon road, over which road it may be brought to Skagway. It is believed that the road will be well supported by the mines.

ELECTRIC RAILWAYS IN SPAIN—In discussing the problem of electric railways in Spain, Benjamin H. Ridgely, consul at Malaga, states that there is a strong feeling in Spain in favor of the American system of electrical traction, as well as of American rolling stock, and if it should be decided to introduce electrical traction very widely, it would appear that Americans interested in such ventures would do well to look into the matter. At a recent meeting of the stockholders of the Orense & Vigo Railway Company, a plan was discussed for applying electrical traction, not only to the line, eighty-two and one-half miles in length, from Vigo to Orense, but to all the railway lines of the important province of Galacia. There is a large waterfall in the midst of these lines, and it is proposed to utilize this for producing power, beginning first on the line connecting the important seaport of Vigo with the large interior town of Orense. Attention is called to the city of Toulouse in southern France. This is one of the largest towns of the French Republic, with a population of about 175,000. It has an extensive street railway system with many suburban lines, but the whole system is operated at present by animal traction. It is thus the only large city in France which has not adopted electrical traction, and it is believed in these quarters that it must soon follow the example of the others.

ELECTRIC RAILWAYS

SAN FRANCISCO, CAL.—The United Railroads Company is working a large force of men on the completion of its line between San Francisco and San Mateo. High speed will be made over a private right of way for a large part of the distance.

WASHINGTON, PA.—Work has been begun by the Mount Washington Tunnel Company on the new tunnel to pierce Mount Washington. In connection with the tunnel there will also be built a new trolley line, which will ultimately extend to Washington, Pa.

REDDING, CAL.—Final surveys have been completed for the proposed electric road from Redding to Keswick. F. G. Parker, promoter of the project, will submit the maps and data to consulting Engineer O'Shaughnessy. Although in a mountain country, the grade does not exceed five per cent at any point.

LOS ANGELES, CAL.—The Pacific Electric Railway Company is rapidly completing its track on the Los Angeles-Long Beach line. The double track is finished to a point within eight miles of the latter place, and the road will be completed by July 1. The length of the road is twenty miles, and the heaviest grade will be less than one per cent. The new cars will be capable of making between fifty and sixty miles an hour.

LODI, CAL.—Two electric railway propositions are being agitated with Lodi as their objective point. One is to construct a line from the water front of Terminous on the Mokelumne River, making connection with steamers from San Francisco. The other project is for a fourteen-mile line extending from Stockton, where H. E. Huntington has purchased the Stockton Electric Street Railway Company, with the idea of making extensions.

YOUNGSTOWN, OHIO—A committee has been organized to formulate plans for a proposed electric line from Conneaut to Youngstown. The object is to form a connecting line between these cities and Ashtabula and Erie. The capitalists interested here are also interested in the new Erie-Conneaut line, construction on which is to be begun very shortly. A line to Youngstown is to be built, and the Conneaut & Southern Railway Company has been organized for that purpose.

CHICAGO, ILL.—The American Railways Company, controlling the Chicago & Joliet Electric Railroad, is surveying a line from Summit to Lyons and proposes to connect with the Consolidated Traction Company this summer. It is said that the cars will be run through to Madison street cable line. The American Railways, owned by Philadelphians, has a large interest in the Union Traction stocks, holding some 5,000 shares of the preferred and 2,000 of the common. The line from Summit to the city limits, connecting with the city railway, will be continued, but the purpose is to make the Lyons route the main line of travel.

TELEPHONE AND TELEGRAPH

TORONTO, ONTARIO—The Bell Telephone Company of Canada has increased its capital stock from $5,000,000 to $6,000,000.

BURNSIDE, KY.—A telephone line is in course of erection from Royalton, Russell County, to Somerset, Faubush and Nancy, a distance of forty miles.

PITTSBURG, PA.—The Federal Telephone Company has offered a reward of $1,000, which will be paid for the arrest and conviction of any person who may be found maliciously destroying or tampering in any way with the wires or service of the company.

ROCHESTER, N. Y.—It is reported that work will be commenced on the new telephone extension of the Business Men's Telephone Company of Western New York, between Mount Morris and Nunda, Nunda Junction, Crook's Grove Ridge, and Mount Morris. This is probably the only extension that will be built this summer by the company.

BRODHEADSVILLE, PA.—At a recent meeting of the Pohoqualine Telephone Company, at Brodheadsville, the contract for constructing a telephone line from that place to Stroudsburg, *via* Scotia, Stormville and Bossardsville, was awarded to Jeremiah Fetherman. The contract calls for the completion of the work by August 1, but it is hoped that the line will be in operation before that time, as work is to begin at once.

MCKEESPORT, PA.—The McKeesport Telephone Company has recently had considerable trouble, due to interference with its service. Cable has been cut in Reynoldstown, and the guide strands sustaining the river crossing construction at McKeesport, and also on the Dravosburg Bridge crossing the Monongahela River. The company has offered a reward of $1,000 for the conviction of the guilty parties in each of these cases.

CHIPPEWA FALLS, WIS.—The Chippewa County Telephone Company is extending its line to Cadott to connect with the Cadott Telephone Company's line, which reaches Boyd, Cadott and Stanley. The Badger State Telephone Company, which has a terminal at Thorp, will extend its line to Stanley this summer and connect with the Cadott company's line. This will connect Chippewa Falls with Marshville, Abbottsford, Greenwood and Neillsville.

NEW HAVEN, CT.—The directors of the East Haven Telephone and Electric Company are investigating and it is expected that an automatic system of some kind will be installed in East Haven. George C. Kirkham, the president, and Henry H. Bradley, the secretary, have been in Providence investigating the workings of the automatic switchboard with a view of installing a plant in East Haven. A number of applications have been received for new telephones to be installed during the summer.

CLEVELAND, OHIO—The People's Telephone Company, of Jackson, Mich., one of the Everett-Moore Syndicate properties, has been sold to Grand Rapids (Mich.) capitalists, who are largely interested in the independent telephone company in the latter city. The consideration has not been made public. Chairman Goff of the bankers' sub-committee, which is handling the Everett-Moore telephone interests, said that the sale of several additional telephone properties would probably be announced within a short time.

CHICAGO, ILL.—The Postal Telegraph and Cable Company has completed arrangements whereby its two offices in this city will be consolidated and established in the Rialto Building, which is to have two stories added to accommodate the new tenant. A lease has been taken for twenty-five years from May 1, 1905. Plans for the additional stories have been prepared under the personal supervision of Superintendent Nally, and provide for operating rooms as well as the comfort and convenience of employés. It is the intention of the owners of the building to make other attractive improvements at an expenditure of $250,000, and an elaborate new marble entrance will be put in the centre of the La Salle street side. The name of the building will be changed to the Postal Telegraph.

FREDERICKSBURG, VA.—A meeting of the stockholders of the Upper Rappahannock Telephone and Telegraph Company was held and organized by the election of the following officers: Robert Beverly, of Essex, president; William Pratt, of Caroline, secretary; A. Randolph Howard, of Fredericksburg, treasurer; Edward J. Smith, of Fredericksburg; A. F. Turner, of Caroline; Harry L. Baylor, of Essex, vice-presidents. To these were added the following as members of the board of directors: William Douglas Carter, Charles I. Stergle, R. L. Biscoe, Fredericksburg; C. I. Motherhead, Henry V. Turner, D. B. Powers, Jr., Caroline; Carter Beverly; Walter J. Parker, R. C. Phillips, Essex. The line will be built at once. Its completion will place this city in connection with the entire northern neck.

LEGAL NOTE

RECEIVER ORDERED TO DISPOSE OF COMPANY'S INTEREST—Upon the application of Norman McD. Crawford, who was appointed receiver of the assets of the Eddy Electric Manufacturing Company, the Court has ordered him to sell as an entirety, without appraisement, the equity of the defendant company, the real estate, manufacturing plant, fixtures, machinery, tools, implements, and other property situated in the town of Windsor, Ct., which is subject to mortgages, deeds of trust, or other liens as appear on record; also the equity or right of purchase of the defendant company in and to the machinery in the receiver's possession; under contract or conditional sale; also all other property of the defendant, real and personal. A public sale will be held in the county building at Hartford, Ct., at twelve o'clock on June 21. No bid will be received less in amount than $24,000, the purchaser to pay at least $4,000 in cash or by certified check satisfactory to the receiver at the time of sale, and the balance within seven days thereafter.

NEW INCORPORATIONS

PADUCAH, KY.—The Paducah City Railway. $300,000.

PLEVNA, IND.—The Plevna Home Telephone Company. $5,000.

LA FONTAINE, IND.—The La Fontaine Telephone Company. $5,000.

WILMINGTON, DEL.—Fontagany Mutual Telephone Company. $50,000.

DES MOINES, OHIO—Dunlap Light, Heat and Power Company. $10,000.

SALEM, ORE.—Cottage Grove Telephone Company. $10,000. Incorporators: B. Lurch, D. Bristow, T. K. Campbell.

MADISON, WIS. — Wausaukee Telephone Company. $10,000. Incorporators: E. F. Fox, A. W. Larson, C. B. Mitt.

CHICAGO, ILL.—Urbana Light, Heat and Power Company. $100,000. Incorporators: M. W. Busey, G. W. Busey and W. I. Soffell.

DENVER, COL.—Grand River Electric Power Company. $100,000. Incorporators: E. S. Douglass, Elen P. Young and Louis R. Tatum.

JEFFERSON CITY, MO.—Liberty Telephone Company. $15,000. Incorporators: S. H. Wordson, J. M. Wordson, P. Parker, S. Parker and others.

ALBANY, N. Y.—International Electrical Manufacturing Company. $50,000. Directors: S. R. Jacobs, Arthur Jacobs, R. E. Leven, of New York.

TITUS, IND.—The Eureka Telephone Company. $10,000. Directors: Jesse E. Gwartney, Charles Yeager, C. E. Faith, J. G. Ballard and L. S. Fleshman.

VERNDALE, MINN.—Central Telephone Company. $10,000. Incorporators: S. L. Frazier, George E. Merrill, W. N. Morrell, H. M. Henderson, of Wadena, and J. Boyd, A. Boyd and P. Boyd, of Central.

WASHINGTON, IND.—The Daviess County Home Telephone Company. $100,000. Directors: Austin F. Cabel, Charles F. Winton, Miles G. O'Neall, James W. Ogden, Henry T. Trueblord and David A. Yode.

EVANSVILLE, IND.—The People's Light, Heat and Power Company. $25,000. Directors: W. F. White, C. W. Wetmore, G. R. Sheldon, M. J. Freiburg, J. G. Schmidlapp, A. B. Vorhies and C. C. Bragg.

SPRINGFIELD, ILL.—Munson Telephone Company; $500; incorporators: F. C. Swiger, V. Hedman, H. Hutchinson. Pontiac Electric Company; $100,000; incorporators: J. A. Carothers, F. L. Lucas, A. C. Norton.

AUTOMOBILE NOTE

SPEED CONTESTS ON HIGHWAYS BARRED—The board of governors of the Automobile Club of America has decided, after a prolonged meeting, that no more speed contests on public highways will be held under the jurisdiction of this association. It was resolved that in order to secure the sanction of a reputable automobile body for race meets, it would be necessary hereafter to obtain a license from the American Automobile Association. These licenses will not be granted to any but bona fide clubs or associations which are devoted to the interests of automobiles.

ELECTRICAL SECURITIES

During the past week speculation was almost completely at a standstill, dealings averaging hardly 2,000 shares per day. In spite, however, of the general dulness and irregularity of prices, the tone of the market has been very steady, and the net changes of prices do not show any distinctive decline. By far the most important event, financially considered, of the week was the declaration of peace in South Africa. While its immediate effect was not very sharply defined, there is no doubt but that ultimately it will be of decided benefit and stimulus, which the world's markets will very generally feel. The end of the war not only relieves the British nation from large expenditures, but it provides an outlet for expanded trade and the investment of capital in South Africa, that can not fail to cause a revival of good trading, the cessation of hostilities meaning that gold mining will be carried on to a much greater extent than for some time. The coal strike has been the most significant speculative factor during the week, and instead of improving, the situation has become materially worse as a result of a partial extension of the labor trouble to the bituminous miners, and by the flooding of the mines and the hostility of the anthracite miners. Considerable faith is held in the latest rumor that a truce will be made until October, which would very materially better conditions at the present time.

ELECTRICAL SECURITIES FOR WEEK ENDING JUNE 7.

New York:	Closing.
Brooklyn R. T.	66⅞
Con. Gas	219⅝
Gen. Elec.	320
Kings Co. Elec	196
Man. El.	130⅝
Met. St. Ry.	148½
N. Y. & N. J. Tel. Co.	174
Westinghouse Mfg. Co.	214

The report of the Metropolitan Street Railway Company for the quarter ended March 31 shows that its operating cost was less than half its earnings for the quarter, and with the taxes on all its property used in operating the road and on earnings and capital stock, but 4½ per cent above half the earnings. The balance-sheet, whose total is $94,417,448, has a profit and loss surplus of $5,342,451. The capital is $51,995,200, the funded debt $21,750,000, the bonds proceeds to the credit of the Metropolitan Street Railway, lessee of the Third Avenue Railway, construction cost $4,304,655, and the bills payable $9,250,000.

The General Electric Company has declared a stock dividend of 66 2-3 per cent, payable July 1, in accordance with the plan announced on May 5 last, when the stockholders voted to increase the capital stock from $25,242,000 to $45,000,000. The purpose of this increase in stock was to pay this dividend, which represents in fact the 40 per cent taken away from the stockholders in 1898, when the stock was reduced by that amount. The stockholders retained 60 per cent of their stock, and a 66 2-3 per cent dividend on that amount now is equivalent actually to the 40 per cent taken away.

Boston:	Closing.
Am. Telep. & Tel.	173½
Edison Elec.	277½
Mass. Elec. pf.	96½
New England Tel.	148
Western Telephone & Telegraph.	100

The directors of the Massachusetts Electric Company have declared a semi-annual dividend of 2 per cent, payable July 1 to stock of record at close of business June 7.

Philadelphia:	Closing.
Elec. Co. of America	7¼
Elec. Stor. Bat. c.	88
Elec. Stor. Bat. pf.	88
Philadelphia Elec.	5
Union Traction.	41½
United G. I. Co.	103½

Upon the news that a decision had been handed down in Buffalo in favor of the Electric Storage Battery Company, this company's stock rallied 2 points. Union Traction and Philadelphia Electric made slight advances.

Chicago:	Closing
Chicago Edison Light	175
Chicago Telep.	170
Metropolitan El. pf.	90
National Carbon	25
National Carbon pf.	91
Union Traction.	18
Union Traction pf.	55

The Chicago Telephone Company has declared a regular quarterly dividend of $2.50 per share, payable July 1. The books will close June 25 and reopen July 2. It is announced in Chicago that the business of the National Carbon Company so far this year is 20 per cent larger than last year for the same period. It is understood that the company is preparing to introduce several new patents in the near future.

ELECTRIC LIGHTING

NASHVILLE, TENN.—The new city electric light plant is nearing completion. Some parts of the machinery are yet to come and be put in place. A consignment of 100 miles of wire to be used on the streets has arrived, and the work of wiring the city is being pushed. Forty miles of wire have been placed on the poles and the cross-beams are ready for the other wire. Superintendent Pentecost states that the plant will probably be ready for operation some time next month.

HELENA, MONT.—In accordance with the order of the court, the street railway, electric light and gas plants of the Helena Power and Light Company have been sold at auction. Thomas A. Marlow, president of the National Bank of Montana, as trustee for a company of eastern capitalists, was the only bidder, his offer being $200,000, the lowest price that could have been entertained under the order of Judge Knowles, of the United States Court in his decree of sale. The equipment of the trolley system is to be increased and improvements will be made on the tracks. The most important work of the new company for a time will be the extension of the line to the capitol, the branch to be built from the Eighth avenue line.

GRAND RAPIDS, MICH.—The Grand Rapids Edison Company has been organized under the New Jersey corporation laws to take over the properties of the Edison Light Company and the Grand Rapids Electric Light and Power Company, recently consolidated and later purchased by a syndicate represented by Rudolph Kleybolte & Company, of Cincinnati. The capitalization of the new company is $1,000,000. The officers of the company are: President, Daniel McCoy, Grand Rapids; vice-president, Mr. Breed, of Cincinnati; secretary-treasurer, Thomas F. Bechtel, Grand Rapids. Directors: Daniel McCoy, Mr. Breed, of Cincinnati; Mr. Goodsell, of Chicago; W. R. Shelby, John A. Covode and Charles M. Ayer, of Grand Rapids.

STATEN ISLAND, N. Y.—At the request of the holders of a large majority of the bonds and stocks of the Staten Island Electric Railroad Company and allied corporations, William Lanman Bull, R. Somers Hayes, John Greenough and Walter G. Oakman have consented to act as a committee for the consolidation and reorganization of the Staten Island Electric Railroad Company, New York & Staten Island Electric Company, Richmond Borough Company, New Jersey & Staten Island Ferry Company, New York Investment and Improvement Company and Richmond County Power Company. A plan for the consolidation and reorganization has been adopted, signed by the committee and lodged with the Guaranty Trust Company, as depositary, and is part of an agreement.

PERSONAL MENTION

MR. STEPHEN D. FIELD, the well-known electrical engineer and inventor, has returned to the United States after a sojourn of over three years in Europe, devoted chiefly to electric railway building. Mr. Field with his family will reside for awhile in Stockbridge, Mass., but will probably subsequently go abroad again where he has large interests.

MR. JAMEES GAYLEY, who has recently been elected to the board of directors of the United States Steel Corporation, has acted as its first vice-president since the formation of the corporation. Mr. Gayley has had general charge of all material and transportation of the mines, ore, coal, coke, limestone, railroads, steamships and ore docks. He is a scientific metallurgist and has made an earnest study of this branch of engineering. Mr. Gayley began his education at West Nottingham Academy, Cecil County, Md., and completed it at La Fayette College, where he was graduated in 1876 with the degree of mining engineer. Many useful appliances have been invented by Mr. Gayley in connection with blasting furnaces, bronze-cooling plates, and carbon bricks for furnace lining, and he has also perfected and patented a process for producing a dry air blast. Mr. Gayley is regarded as an authority on metallurgy, and has contributed many articles to scientific societies, which are quoted in the United States and abroad. He belongs to several clubs in Pittsburg, and is a member of the American Institute of Mining Engineers, and the Iron and Steel Institute of Great Britain.

INDUSTRIAL ITEMS

MR. C. K. HILL, Pittsburg, Pa., dealer in electrical supplies, has recently moved into new and larger quarters.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., has issued a neat pamphlet containing descriptions and sizes of small power motors.

THE SUMTER TELEPHONE MANUFACTURING COMPANY, Sumter, S. C., has issued three fine bulletins, Nos. 20, 21 and 28, describing a splendid line of new apparatus.

MR. A. L. DYKE, St. Louis, Mo., manufacturer and jobber of automobile parts and supplies, has just issued a very complete catalogue of appurtenances for every condition of automobile supply.

THE C. W. HUNT COMPANY, New York city, has issued an interesting pamphlet on the subject of "Economical Coal Handling." This is described very fully, and is supplemented by numerous fine half-tones.

FROST & ADAMS COMPANY, Boston, Mass., are placing on the market a cylindrical pocket calculator, which is essentially an extension of the straight slide rule put into such compact form that it is easily carried about.

THE STANDARD POLE AND TIE COMPANY, 44 Broad street, New York, advises us that it is so well equipped for the season's construction work that it can promptly furnish on requisition poles for electric railway, light, telephone or telegraph construction service.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., is carrying a large stock in Chicago of the Packard incandescent lamps, for which it is the general selling agent. The company is in a position to make quick shipments on rush orders of any size of the regular lamps.

THE ELECTRIC INSULATION COMPANY, a New Jersey corporation, the chief stockholders of which are supposed to be New York interests, have voted to dissolve the corporation. It has been announced that this company bought a secret process which did not fulfill the expectations of its purchasers.

THE AMERICAN ELECTRICAL MANUFACTURING COMPANY, 931 Chestnut street, Philadelphia, is now offering to prospective buyers the "Heany" enclosed arc lamp. The construction and operation of this lamp were carefully and fully illustrated in the pages of the ELECTRICAL REVIEW some weeks ago.

THE ATWOOD-KENT MANUFACTURING COMPANY, 116 North Seventh street, Philadelphia, is offering a new type of interior telephone known as the "Monoplex." This instrument is installed on the one-wire system, and is recommended for hotels, factories and general interconnection service.

THE TWENTIETH CENTURY TRAINS going into service on June 15, making a fast run of 980 miles between New York and Chicago, it is announced, will be equipped with the "axle" light system of electric lights and fans manufactured by the Consolidated Railway Electric Lighting and Equipment Company, New York city.

THE NEW YORK CENTRAL & HUDSON RIVER RAILROAD COMPANY, in Nos. 4 and 5 of its "Four-Track Series," has compiled much that will be of interest to those who contemplate suburban homes north of the Harlem River or those who are anticipating a brief rest in rural districts not far from New York city.

THE ELECTRIC LAUNCH COMPANY, Bayonne city, N. J., has favored some of its friends with a magnificent catalogue describing and illustrating its electric launches. The book contains 120 pages and is very carefully printed. The descriptions of the different types of boats are very complete, and the whole is a very effective and desirable souvenir advertisement booklet.

MR. JOHN DONNELLY, Branford, Ct., is the sole maker of the well-known Donnelly climbers for linemen. These climbers can be respurred, the two spurs being mailed by the maker at a small nominal cost. As Mr. Donnelly will hereafter sell these climbers direct to the trade—they being formerly handled by Mr. J. J. Redy, of New Haven—all enquiries will be sent to John Donnelly, at Branford, Ct.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is now ready with its revised discount sheet and price list. This is entitled as "An Addenda to the Twentieth Century Encyclopædia of Electrical Supplies." This discount list is very carefully compiled, and it is hard to find where there is anything lacking in its make-up. The general index is very complete and includes of itself sixteen full pages.

THE WESTERN ELECTRICAL SUPPLY COMPANY, St. Louis, Mo., states that the demand for its Adams secondary generator, recently placed on the market, has been entirely satisfactory and very large. In addition to orders for this instrument from all over the United States, a large number of enquiries has come from abroad. Attractive printed matter fully describing this will be mailed on application.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., has printed some very interesting matter on "Recent Transformer Litigation" and the S. K. C. type A. O. oil lighting transformers. This describes the regulation, core loss, mechanical design, three-wire distribution, and aging of oil transformers, the different parts of these transformers in successive stages of assembly being carefully illustrated.

THE SAFETY INSULATED WIRE AND CABLE COMPANY, New York city, contemplates another edition of its remarkable pamphlet on the question of whether the Pacific cable shall be under United States control or under foreign control. The demand for this pamphlet was greatly in excess of the original editions, and it is owing to the number of enquiries that the company finds it necessary to get ready another edition.

THE SPRAGUE ELECTRIC COMPANY, New York city, has recently received an order from the Pennsylvania Steel Company for ten electric trolley hoists for use in the new bridge shop at Steelton, Pa. These hoists are of the new type of worm-gear trolley hoist manufactured by this company and combine extraordinary lifting capacity with light weight and compactness. They are controlled from the cage and have a lifting speed of twenty feet per minute.

THE OHIO BRASS COMPANY, Mansfield, Ohio, reports an unprecedented success in the introduction of the new "All Wire" bond which this company has been introducing to the street railway companies during the last few months. This bond, owing to its peculiar construction, may be made in a large variety of shapes corresponding to nearly every type of bond on the market. This bond, which has been illustrated in the columns of the ELECTRICAL REVIEW, is well described in a bulletin issued by the company.

THE CHAPMAN VALVE MANUFACTURING COMPANY, Indian Orchard, Mass., is distributing a handsome souvenir of the annual meeting of the American Society of Mechanical Engineers, held in Boston, Mass., in May. The Chapman Valve Manufacturing Company is making a specialty of the adoption of electric motors in the operation of valves and sluice gates, and a number of different applications of individual motors to these devices is splendidly printed on heavy ivory paper. The souvenir is enclosed in a substantial envelope stamped in gold with the company's seal, and is well worthy of preservation.

PARAGON FAN AND MOTOR COMPANY, New York city, is submitting a catalogue describing the Paragon sewing-machine transmitter. This the company claims to be the highest development in the operation of sewing machines by means of electric motors. It can be applied to any machine without mutilating any part, and runs only with the operation of the sewing machine. It takes power in proportion to the amount of work being done and the speed and number of stitches per minute, having an available speed under control of the operator from two stitches per minute to two thousand, and, if desired, starts immediately at full speed.

TELEPHONE IN EVERY ROOM—The growing demand for the telephone service is illustrated by the fact that during the past week four of the leading New York hotels have contracted with the New York Telephone Company for the installation of branch telephone exchanges, by means of which the general telephone service is made available in every room and working department of the hotel. The Manhattan Hotel requires an equipment of 678 stations, the Holland House 350 stations, the Imperial 325 stations, and the Hoffman House 200 stations. The New York Telephone Company has made a specialty of the private branch telephone exchange, which puts the service on tap in every department of a large office or building, a convenience so obvious in the case of city hotels that it is being extensively adopted by hotel managers who wish to have their establishments thoroughly up to date.